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## **SECTION 4.0 - ALTERNATIVES ANALYSIS**

## **4.0 ALTERNATIVES ANALYSIS**

### **4.1 Introduction**

This section of the New Bedford/Fairhaven DMMP DEIR presents the alternatives for the disposal or management of UDM as well as a comparative assessment of the environmental impacts of each alternative. Both state and federal laws guide the development of the alternatives analysis contained in this section of the DEIR. The two principal statutes are:

(1) Massachusetts Environmental Policy Act (MEPA), Massachusetts General Laws (MGL) Chapter 30, Sections 61 and 62A-H. MEPA is the environmental review statute of the Commonwealth, and is the law under which this DEIR is being prepared. MEPA provides an opportunity for public review of potential environmental impacts of projects for which state agency actions (e.g., permits, funding, or agency-sponsored projects) are required. Most important, MEPA functions as a vehicle to assist state agencies in using: "... all feasible means to avoid damage to the environment or, to the extent damage to the environment cannot be avoided, to minimize and mitigate damage to the environment to the maximum extent practicable." (MEPA, 1998)

MEPA requires an analysis of "reasonable alternatives and methods to avoid or minimize potential environmental impacts" (301 CMR 11.07(6)) and that all "feasible" alternatives be analyzed in an EIR. Feasible alternatives means those alternatives considered: "... in light of the objectives of the Proponent and the Mission of the Participating Agency, including relevant statutes, regulations, executive orders and other policy directives, and any applicable Federal, municipal, or regional plan formally adopted by an Agency or any Federal, municipal or regional governmental entity" (301 CMR 11.07(6)(f)).

(2) Clean Water Act (CWA), in particular the Section 404(b)(1) guidelines of the US Environmental Protection Agency (Title 40, Code of Federal Regulations (CFR), Part 230), require that "practicable" alternatives to a proposed discharge to waters of the United States be considered, including avoiding such discharges, and considering alternative aquatic sites that are potentially less damaging to the aquatic environment. The goal of the Section 404(b)(1) guidelines is to provide a framework for arriving at the Least Environmentally Damaging Practicable Alternative (LEDPA). While the alternative selected for implementation needs to be the least environmentally damaging, i.e. resulting in the least amount of human and natural environment impact of the alternatives studied, it also needs to be practicable. The term "practicable" means "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes."

In consideration of the above, the alternatives for New Bedford/Fairhaven Harbor included in this section of the DEIR are those alternatives for the disposal and/or reuse of UDM.

### **4.2 No Action Alternative**

Consideration of the no action alternative for the New Bedford/Fairhaven Harbor DMMP is required under the MEPA Regulations at 301 CMR 11.07(6)(f). The no action alternative is used to provide a future baseline against which the impact of the preferred alternative(s) is (are) measured, compared and

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contrasted. It is representative of future conditions in New Bedford/Fairhaven Harbor, without the changes or activities that would result from the implementation of the preferred alternative(s) for disposal of UDM.

The no action alternative assumes that dredging activities involving the removal of sediments that are unsuitable for unconfined open water disposal would not occur. It is estimated that approximately 960,000 cy of sediment to be dredged from New Bedford/Fairhaven Harbor over the next 10 years is unsuitable for unconfined open water disposal. Therefore, under the No Action alternative, this 960,000 cy of sediment would not be dredged.

Existing sedimentation rates in New Bedford/ Fairhaven Harbor would continue unabated and the navigation channels would slowly fill in. The USACE estimates that the federal navigation channels receive a net volume of 23,000 cy of sediment per year, which equates to approximately 0.5 inches within the channels (USACE, 1996). The approximately 30 dredging projects and activities which have been identified to continue economic growth in the Cities of New Bedford and Fairhaven in their Harbor Plans would not occur.

Specifically, for the New Bedford/Fairhaven Harbor DMMP, no aquatic or upland disposal sites for UDM would be constructed and future environmental impacts which would result from their construction and use would be avoided. If an aquatic disposal site is not constructed, temporary aquatic environmental impact such as impacts to benthic invertebrates or alterations to deep water environments would not occur (Section 6.2 Benthos). Furthermore, if a upland disposal site is not constructed, environmental concerns associated with oxidation/acidification, dust and odor nuisances and leaching of heavy metals and salts would not result.

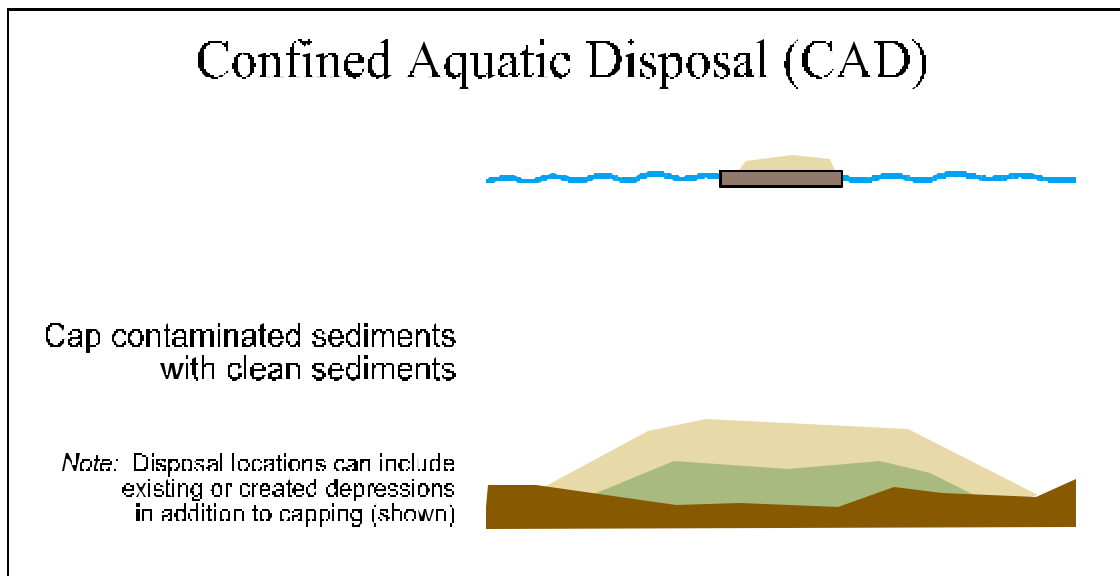
### **4.3 Description of Disposal Alternatives**

#### ***4.3.1 Aquatic Disposal Alternatives***

The following describes several types of aquatic disposal methods considered for the disposal of dredged material. Generally speaking, the primary advantages of open water disposal over other disposal alternatives are typically the large disposal capacity, relatively short-term environmental impacts, and lower relative cost (Carey et al., 1999). The primary disadvantages of aquatic disposal include potential changes in benthic habitat quality and temporary water quality degradation, as well as complex logistics associated with certain types of aquatic disposal. The complexity of aquatic disposal is due to the interdependence, sequencing and timing of dredging, storage and disposal operations.

##### **4.3.1.1 Confined Aquatic Disposal**

Confined aquatic disposal (CAD) is the process where dredged material that is unsuitable for unconfined open water disposal is deposited into the marine environment within a confined area, and then covered with suitable material (Figure 4-1). There are basically two methods of constructing a CAD site. Most commonly, CAD sites are created by placing unsuitable material on the existing seabed, and then covering it with clean dredged material which is considered suitable for open-water disposal. The overlying layer is commonly referred to as a cap, typically constructed



**Figure 4-1:** Schematic of Confined Aquatic Disposal (CAD) Mound Method

using either dredged silt or sand. This method has been used in open-water disposal sites in New England (e.g., DAMOS 1994), New York (SAIC 1998), and elsewhere, and requires that sufficient suitable material be available to provide complete capping of UDM. In exposed offshore regions in Buzzards Bay, sites with topography conducive to confinement were preferred, in water depths of at least 65.6 feet (20 meters) to maximize protection against storm-driven waves.

The second method of constructing a CAD site is to excavate a confined area, or pit, which is then filled with UDM and capped. In general, these sites can be created in shallower water, but require water depths in excess of 20 feet (6.1 m), so that dredges and barges which are used to create the pit can access the area. Two types of CAD pits are presented for possible use:

**Overdredge (OD)** - CAD sites located within an existing channel that are dredged below the proposed navigational depth, then filled with dredged material and capped to the proposed navigational depth (Figure 4-2); **Adjacent-to-Channel (ATC)** - CAD sites that are created along-side existing channels and/or anchorage areas.

The **OD** method was employed for the BHNIP (NAE and Massport 1995; DAMOS 1999). In this method, the pits are excavated in the channel, and then filled and capped up to or below the existing maintenance depth. If the overlying sediments in the channel are unsuitable, these are first removed and stockpiled. Dredging then continues into underlying suitable sediments, creating a pit below the designed channel depth. Suitable material is disposed of in an approved offshore disposal site (e.g. MBDS). UDM (including the stockpiled channel cover) is then deposited in the pit and covered with suitable material. In the BHNIP, the cap design was for three feet of sand, although alternative cap material can be considered. The selection of an appropriate cap material is dependent upon the environmental objectives of the CAD design, as well as the geotechnical properties of the sediment to be capped.

The **ATC** method is similar to the OD method, except that the pits are excavated in areas near, but outside, the project dredging area. The ATC can be dredged into existing bottom, but is limited only

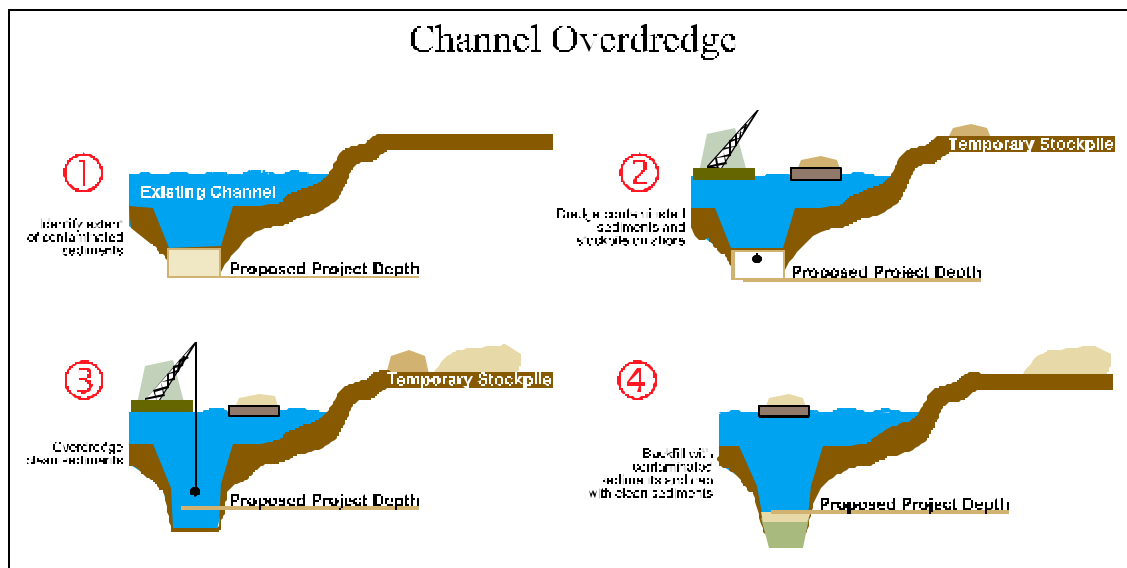
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by the existing water depth rather than the maintenance depth of the channel. As with OD sites, if the overlying sediments prove to be unsuitable, the removed material also needs to be stockpiled for eventual deposition into the ATC pit.

The OD and ATC CAD alternatives have the advantages of locating the disposal site near an existing dredged area (the channel), causing only temporary disturbance of the bottom resulting in rapid biological recovery of the sea floor, and disposing of the material in an inner harbor area that is already impacted by human activity. When the OD site is located near the area being dredged, the additional advantages include (NAE and Massport 1995):

- 1) confinement of the disposal impacts to areas impacted by dredging;
- 2) sequestering the material near the point of origin; and,
- 3) compartmentalizing dredging and disposal operations.

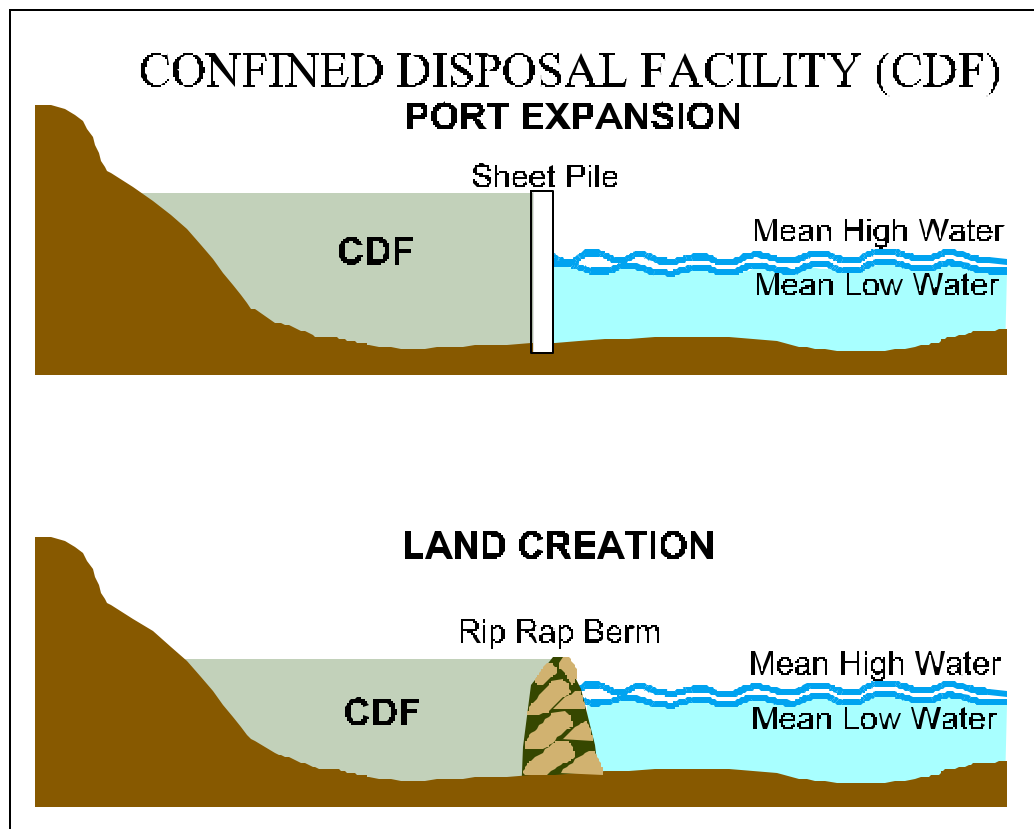
Relative to the first type of CAD site in which no pre-dredging is required, the OD and ATC methods have the disadvantages of requiring additional dredging, longer project duration, greater material handling, larger disposal volumes (the material removed to create the pits), and increased costs. In addition, for OD sites, if the top-of-cap elevation is set as the channel depth, this method precludes future dredging of the channel to deeper design depths without first removing the previously deposited contaminated sediments. Where future navigational improvement projects are being contemplated, the OD top-of-cap elevation must include an adequate depth contingency to accommodate additional channel depth associated with planned future navigational improvement projects. One advantage of the ATC design is that there is no concern that the material will be disturbed by future maintenance dredging of existing navigational dredging projects.



**Figure 4-2:** Schematic of Channel Overdredge (OD) Method

#### 4.3.1.2 Confined Disposal Facility

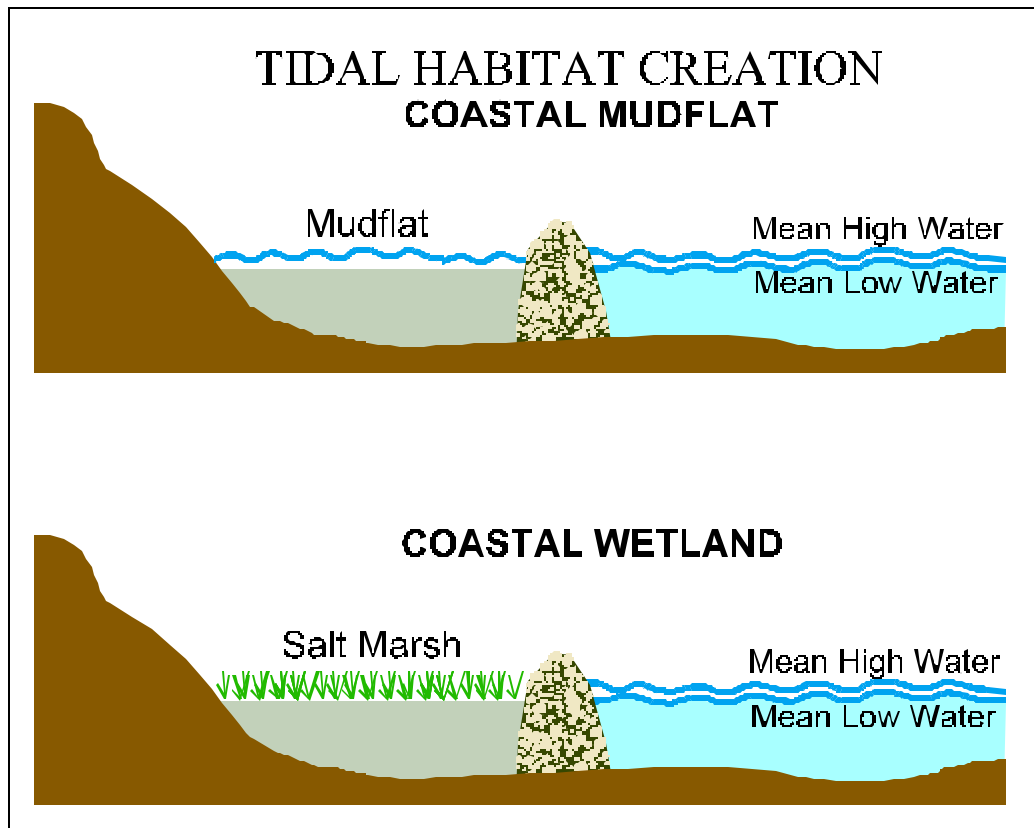
UDM may also be disposed in confined disposal facilities (CDFs), illustrated in Figure 4-3. Creation of a CDF requires construction of confinement walls, typically steel sheet pile, or a confinement berm of earth or stone. Stone reinforcement (rip-rap) may be required on the seaward side of confinement walls and berms to protect them from wave action and tidal scouring. An impermeable liner and cap may also be required, depending on the chemical characteristics of the dredged material. The liner and cap may be made of impermeable soils, such as clay, synthetic materials such as high density polyethylene (HDPE), or some combination of these two. Leachate collection, treatment and disposal may be necessary for lined cells during the construction period to control rainwater infiltration until the cap can be placed over the cell. CDFs have the advantage of isolating UDM from the environment, while at the same time creating new land which can be put to constructive uses, such as port expansion, development, open space, parkland, or upland wildlife habitat. Alternatively, the CDF can be left as a subaqueous area, creating additional wetlands, as discussed in the section on Tidal Habitat, below. CDFs have the disadvantages of: permanently displacing existing tidal and subtidal habitat; being relatively expensive to construct; and, requiring periodic maintenance to ensure the long-term structural integrity of the CDF.



**Figure 4-3:** Schematic of the Confined Disposal Facility (CDF) Method

**4.3.1.3 Tidal Habitat**

A tidal habitat site is a special type of CDF, developed specifically for creation of tidal habitats such as mudflats and coastal wetlands (Figure 4-4). The tidal habitat method requires a cap of material that is chemically and physically able to support biological activity. The tidal habitat method requires creation of an impoundment to retain the dredged material and protect the newly created habitat from scouring currents and wave action. This is typically accomplished by building a berm or breakwater of stone, or of soil armored with stone, up to an elevation above high water. The berm would be penetrated by one or more culverts, enabling sea water to flow through the berm and equalize tide elevations on both sides. The area inside the berm can then be filled with dredged material. The surficial sediments that will be exposed to biological activity must be suitable material (similar to a CAD cap) in order to prevent bioaccumulation/biomagnification and bioturbation of contaminants.



**Figure 4-4:** Schematic of the Tidal Habitat (TH) Creation Method

To create an intertidal mudflat, the area is filled to the elevation of mean sea level. This ensures that the surface will be covered with water at high tide and will be exposed at low tide. Tidal mudflats provide habitat for a wide range of invertebrate organisms, which, in turn, are an important source of food for shorebirds. To create tidal wetlands (i.e. salt marsh), the area is filled to an elevation that ensures that the surface will be flooded periodically, saturated most of the time, and exposed at low tide. Once the surface has stabilized, it is planted with species such as salt marsh cordgrass (*Spartina*

*alterniflora*), salt meadow cordgrass (*Spartina patens*), and big cordgrass (*Spartina cynosuroides*). Salt marsh wetlands provide habitat for a wide range of invertebrate organisms, and are used as nurseries for many species of marine fish. These organisms are an important food source for shorebirds, waders and certain waterfowl.

Tidal habitat alternatives have the advantage of creating additional habitat in, or proximal to, densely developed urban areas (thereby restoring the functions and values of a natural coastline). They have the disadvantages of: displacing existing tidal and subtidal habitat; having low capacity relative to the total quantity of material to be dredged; being relatively expensive to construct; and requiring on-going monitoring and maintenance to ensure the integrity of confinement and the success of the created habitats.

#### 4.3.2 Relationship of Alternative Treatment Technologies, Dewatering and Upland Disposal

Alternative treatment of marine sediment, dewatering and upland disposal are often components of a single logistical system for the handling/disposal of UDM. Depending on the characteristics of the sediment (its composition and mixture of contaminants), UDM must be handled, stored and transported several times before its ultimate disposal or use in the upland environment.

As illustrated in Figure 4-5, UDM first leaves the barge for storage, dewatering and/or treatment at a shore-side location. This location is referred to as a dewatering site. While at the dewatering site, the sediment will be placed in piles where the sediment will dry and the water will evaporate and run-off. This dewatering process may also be accelerated by use of mechanical devices such as a belt filter press. Sediment may be processed through a number of treatment methods to eliminate adverse

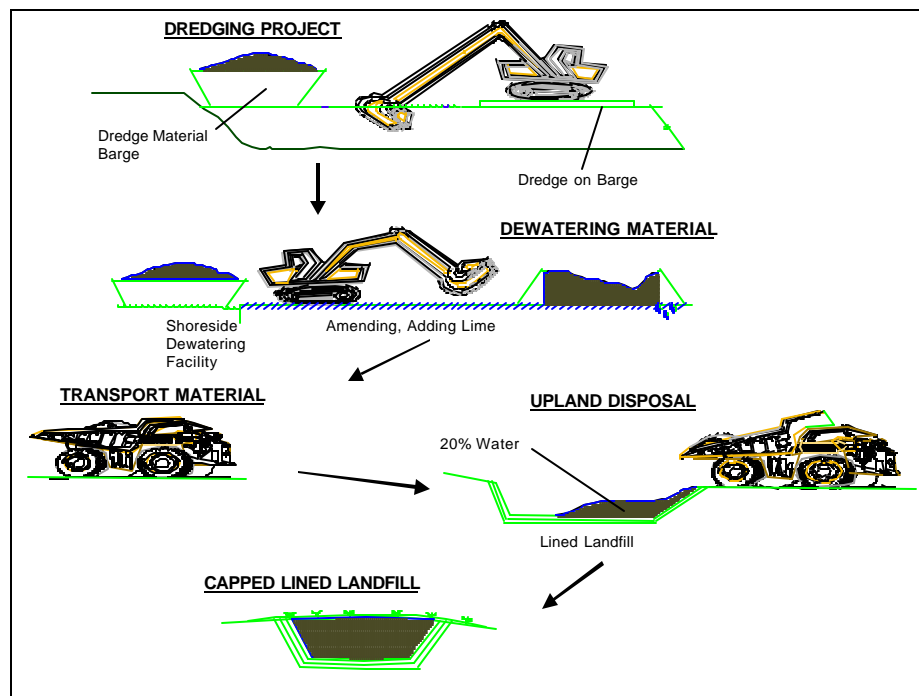


Figure 4-5: Upland Disposal Process



impacts from contaminants. Treatment may be as simple as adding other substances to the sediment to solidify or chemically stabilize the dredged material. Treatment may also be quite complex involving incineration or a series of other processes which in themselves create environmental impacts. For upland disposal, a range of locations is possible: from active landfills to vacant parcels that may be converted to environmentally sound disposal sites for UDM. Each of these components of a non-aquatic disposal system have alternative choices within them. There are numerous types of alternative treatment technologies; several shore-side locations as potential dewatering sites and many locations as potential disposal sites for UDM. The following sections address alternatives within each of these non-aquatic disposal system components.

### ***4.3.3 Alternative Treatment Technologies***

Alternative treatment technologies involve the treatment of contaminated sediment, using one or more processes, to allow for reuse of the sediment in a safe manner in the upland environment or for unconfined open water disposal. There are four general types of treatment technologies, categorized based on their effect on the contaminants of concern within the sediment:

- 1) *Destruction*: the removal of contaminants from the sediment via physical, chemical or biological agents;
- 2) *Separation*: the process of removing contaminants from the sediment resulting in a concentrated residual of contaminated sediment of significantly smaller volume;
- 3) *Reduction*: the process of reducing the amount of contaminated dredged material that requires treatment by screening sediments into various particle sizes; and,
- 4) *Immobilization*: the fixing of contaminants in the dredged material which keeps the contaminants from being released to the environment.

Destructive methods are generally the most complex and expensive forms of treatment. Some of the destructive methods assessed in the DMMP include: incineration, pyrolysis, solvent extraction, thermal desorption and vitrification. The costs for such technologies range from \$161-420/cy (Maguire Group Inc., 1997a).

Separation of contaminants from the sediment can be accomplished by solvent extraction and other techniques. These processes result in a residual material that requires disposal and/or further treatment. The average cost for solvent extraction is \$182/cy (Maguire Group Inc., 1997a).

The primary method of reduction used today is soil washing, a process where water is used to separate the sediments by particle size into a reusable bulk fraction, and a smaller fraction containing concentrated contaminants. Because organic contaminants are often sorbed (adhered) to the finer sediment particles such as silts and clays, separation of this fine soil fraction from the coarser, sandy sediments allows for the reuse of the sand and an overall reduction in the volume of UDM. The average cost for this technology is \$89/cy (Maguire Group Inc., 1997a).

Immobilization techniques evaluated in the DMMP include chelation and solidification/stabilization. Costs for such processes range from \$75-\$90/cy (Maguire Group Inc., 1997a). Some of these processes, such as solidification/stabilization, can produce a material with sufficient structural bearing strength to allow for use as structural fill in construction projects.

#### ***4.3.4 Dewatering Alternatives***

In order to implement an upland disposal or alternative treatment option, a shore front site with adequate land area to dewater the dredged material is required. A dewatering site (or sites) is necessary to provide an area to reduce the moisture content of dredged material, allowing it to be processed and transferred to an upland disposal site for final disposal or reuse.

The process to prepare dredged material for final upland disposal or reuse involves the following primary site functions: off-loading; material screening; lime treatment; soil amendment; and transfer to disposal/reuse site.

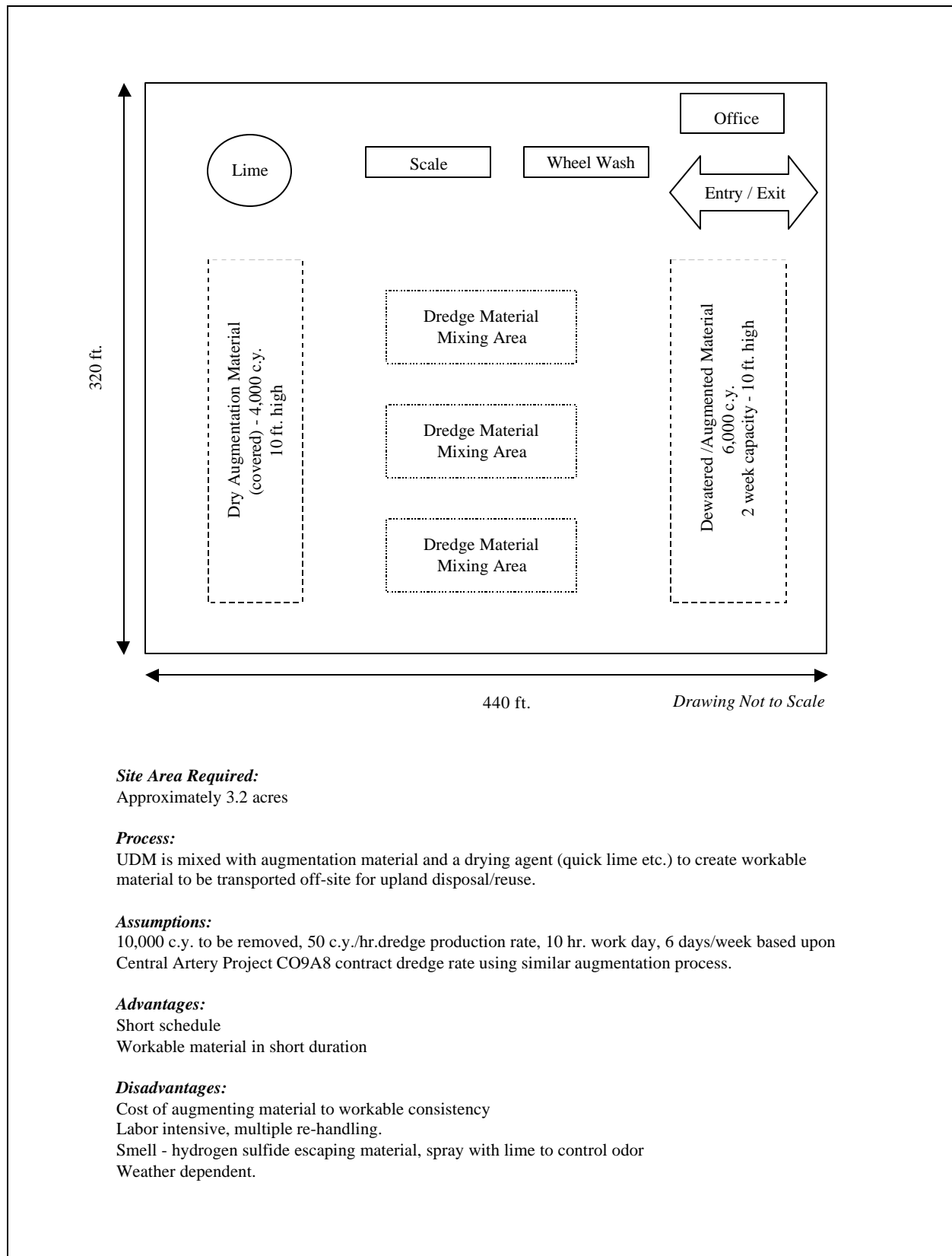
*Off-loading* of the dredged material requires that the barge be tied to a pier or seawall along the shore front. Front end loaders or cranes are used to unload the dredged material from the barge and place it on the site or in dump trucks which move the material to a specific location on the site. If the dredged material has a high water content, water-tight crane buckets and dump trucks may be required to minimize the uncontrolled discharge of sea water and suspended sediment into the water.

*Material screening* is often required to screen out large pieces of debris, such as piling fragments, fishing gear, and other debris typically encountered in an urban harbor environment. This material must be removed from the dredged material and disposed of separately.

*Lime treatment* is often required to reduce the moisture content of the dredged material and to control odors. Anaerobic decomposition results in the production of a strong, sulfur odor that may be controlled via lime additions to the dredged material. Dredged sediment with a high organic content has often undergone long term anaerobic (without oxygen) decomposition in the marine environment. Lime treatment also reduces the moisture content of the dredged material, and results in a material which is easier to handle and spread.

*Soil amendment* of the dredged material is often required to produce a final product that is suitable for various end uses. UDM is typically a fine grained, silty material. The removal of excess water from dredged material through active site management may add considerably to containment area storage volume especially in the case of fine-grained dredge material (USACE, 1983). Mixing or amending UDM with a coarser material such as sand improves the workability of the material. DEP has typically required that amendment of the dredged material be performed within the dewatering site; before UDM is transported upland.

*Transport* of the dredged material to the final disposal or reuse site is required. Truck transport is the most common method. Water transport via barge or alternative land transport such as rail is also possible, but less common. Space must be available within the dewatering site to allow for loading of the transport vehicles.



**Figure 4-6:** DMMP Dewatering Site Conceptual Layout

Ideally, the performance of all the above functions are conducted at one dewatering site, minimizing the number of times the material is transported and reducing overall costs.

Potential environmental impacts associated with dewatering may include pollution due to a release of contaminants in the effluent during dewatering operations. Dewatering of UDM material also has potential environmental advantages because the result of the process produces soil that can be considered for beneficial uses.

To determine the minimum area required to process dredged material for upland/reuse disposal from a 10,000 cy dredging project, dewatering site logistics and area requirements were investigated for the DMMP. The site area requirements developed included the application of lime to control sulfide reactivity, and amendment of the material as per DEP policy. The typical dewatering site requires adequate area for mixing, lime storage, augmenting material storage, truck scale and wheel wash, and approximately a one week storage capacity for dewatered material.

Assuming a facility through-put capacity of 400 cy per day, based upon a typical workday (50 cy per hour times 8 hours per day), a 3.2 acre site (approximately 320-feet by 440-feet) is required. Figure 4-6 illustrates a conceptual site layout and requirements for the facility. When mobilization and construction of containment structures (4 weeks), duration of dredging (5 weeks) and restoration of the site (3 weeks) are factored in, the total time required to process 10,000 cy of material is approximately 12 weeks, or 3 months.

The projected volume of UDM from New Bedford/Fairhaven Harbor in the first five year planning horizon is 680,000 cy. The theoretical 3.2 acre dewatering site could process the material for upland disposal/reuse in about 75 weeks (5 weeks for every 10,000 cy + 7 weeks mobilization/demobilization). The above numbers represent the best-case scenario; scheduling conflicts and weather delays will extend the processing time.

Seasonal dredging restrictions imposed to protect fish spawning would require dredging to be spread out over several years, given the limited throughput capability of a small dewatering site. Dredging in most areas is limited to the late fall and winter months, a 5-month (22-week) period. With one dewatering site, 3.2 acres in size, the maximum volume of dredging that can occur in any one dredging season is about 30,000 cy.

As part of the DMMP DEIR process of exploring potential dewatering site options, the screening process focused on a universe of potential sites within the municipal boundaries of New Bedford and Fairhaven.

A total of 10 potential dewatering sites were identified. The sites were identified by examining aerial photographs and via windshield surveys conducted in 1998 and 1999. Also, meetings were held with local municipal officials to aid in the process of identifying vacant, open or undeveloped waterfront site as a potential location for dewatering.

### *4.3.5 Upland Disposal/Reuse Disposal Alternatives*

Upland reuse disposal alternatives involve the placement of UDM on land. The land site can be an existing active or inactive landfill, or a raw parcel of land. Dredged material can be used as daily cover or final cover for landfills, provided the material meets the physical and chemical specifications for such use. Dredged material placed on a raw parcel of land could be managed as a landfill, or could be used as a grading material that has some end use (e.g. ball fields, golf course, etc.), provided the physical and chemical properties of the dredged material permit such use. There are currently no regulations in Massachusetts which specifically apply to the disposal of dredged material in the upland environment, therefore the disposal of the material is regulated under the Commonwealth's Solid Waste Management Regulations (310 CMR 16.00 and 19.000). Dredged material, when amended with other material such as Portland cement, can be used as structural fill in construction projects.

The environmental advantages of an upland reuse disposal alternative are threefold. First, the containment of UDM material into a well engineered and monitored situation. Second, a reclamation of the dredged material into a stable soil form can be utilized in engineered construction (i.e. port expansion, recreation and commerce) and, third, the creation of stable, fast land at the disposal site itself, with a final elevation of known geotechnical properties (USACE, 1983). The environmental disadvantages include the potential for leachate to contaminate the water supply and the large dewatering area that would be required for the volume of UDM proposed. Furthermore, the future land use of the site might be limited due to the classification of the UDM material.

The cost for upland disposal ranges from \$62 - \$333/cy for silty UDM that is not suitable as final cover for landfills. Clayey sediments that could be used as final cover material would be slightly less expensive to dispose of in a landfill.

Table 4-1, provides a descriptive summary of all disposal alternatives considered for UDM for New Bedford/Fairhaven Harbor.

**Table 4-1:** Disposal Types - General Summary Matrix

<b>Disposal Type</b>	<b>Benefits</b>	<b>Drawbacks</b>	<b>Contaminant Pathways</b>
<i>CDF</i>	Contaminated sediment sequestered from marine environment; creation of new land for port expansion, recreation, commerce, etc..	Permanent loss of subtidal and intertidal habitat; fine sediments may require extensive dewatering time, restricting use of the site for extended period.	Birds and small mammal can be temporarily exposed to contaminants in soil and potentially ingest contaminated organisms before cap placement.
<i>CAD - In Channel</i>	Contaminated sediment sequestered from marine environment; impact occurs within already disturbed area; relatively low cost	Technology of capping not perfected; limits potential future dredging depths; short-term water quality impacts; permanent change to bathymetry of disposal site	Suspended particulate matter released during disposal can affect water column
<i>ATC-CAD</i>	Contaminated sediment sequestered from marine environment; relatively low cost; close to channel dredging areas	Technology of capping not perfected; ATC areas may not be degraded, therefore high value bottom habitat can be impacted; short-term water quality impacts	Suspended particulate matter released during disposal can affect water column; potential change in substrate type.
<i>CAD</i>	Contaminated sediment sequestered from marine environment; relatively low cost;	Technology of capping not perfected; CAD areas may not be degraded, therefore bottom habitat can be impacted; benthos impacts, short-term water quality impacts; large volume of capping material required to cover mound	Suspended particulate matter released during disposal can affect water column; potential change in substrate type.
<i>TH</i>	Creation of salt marsh or tidal flats beneficial to water quality and wildlife.	Contaminated sediments cannot be used for habitat creation because of potential bioaccumulation/biomagnification/bioturbation of contaminants.	Benthic organism and plants living in contaminated sediments can transfer pollutants within food web.
<i>Upland</i>	Removal of contaminants from marine environment into a well engineered and monitored situation.	Large dewatering area required; air quality, noise, traffic impacts; high cost; future use of disposal site permanently affected due to classification of material as solid waste	Potential groundwater contamination from leachate; air quality impacts from fugitive dust and odor
<i>Alternative Treatment Technology</i>	Removal of contaminants rendering sediment potentially suitable for ocean disposal or beneficial reuse (tidal habitat creation)	Cost prohibitive, particularly for small projects. Residuals may require treatment. Potential air emissions.	Air and wastewater emissions from processes.

### 4.4 Disposal Site Screening Process

The disposal site screening process is designed to assess all possible alternatives through the sequential application of environmental, social and economic criteria. As sites with significant conflicts are removed from consideration, the assessment of remaining sites becomes more detailed. Ultimately, only those sites with minimal or no conflict with the criteria are subjected to intensive evaluation to determine which remaining sites best meet the goals of the New Bedford/Fairhaven Harbor DMMP.

A universe of disposal sites was developed during Phases I and II of the DMMP, including historic dredged material disposal sites recommended by the USACE as well as sites suggested by the New Bedford/Fairhaven Dredged Material Management Committee. These were evaluated in a tiered process. The result of this process is the identification of a range of practicable and reasonable disposal site alternatives. These sites, determined through the evaluation process described below, are evaluated in detail in this DEIR.

The types of disposal sites and methods identified through this process include: Adjacent to Channel (ATC), Channel Over Dredging, Confined Aquatic Disposal (CAD), Capping (CAP), Confined Disposal Facility (CDF) for land creation, Tidal Habitat Creation (mudflat or marsh), upland (reuse or disposal), and alternative treatment technologies.

The disposal site screening criteria described in this DEIR were developed independently, based on published federal and Massachusetts disposal siting criteria and conforming with the Providence River and Harbor Maintenance Dredging Project Draft Environmental Impact Statement (USACE, 1998). The evaluation factors used in the Providence River DEIS were reviewed by the USEPA, USFWS, NMFS and Massachusetts regulatory agencies to obtain their concurrence with the criteria that would be the basis for disposal site decisions. The evaluation factors were also reviewed by the Dredged Material Management Committee.

The disposal site screening process includes four categories of evaluation criteria: criteria for all sites, criteria for aquatic disposal sites, criteria for upland disposal sites, and criteria for beneficial uses. The process of site screening is generically illustrated in Figure 4-7. Each disposal alternative category listed above underwent this screening analysis, with some variation during one or more stages of the process to account for the unique issues associated with each type of alternative. The site screening process for these categories is described in Sections 4.5 through 4.8.

The screening criteria were applied in sequential phases to each of the two major disposal site option groups (i.e., upland and aquatic). The first phase of the screening process ("Feasibility Screen") was to eliminate sites that are clearly a poor choice for disposal of dredged material because of one or more of the following: the surrounding land uses (for upland sites), their inaccessibility relative to the type of disposal proposed, their inability to contain a sufficient volume of material. Sites that are not feasible disposal options are permanently eliminated from further consideration under the DMMP.

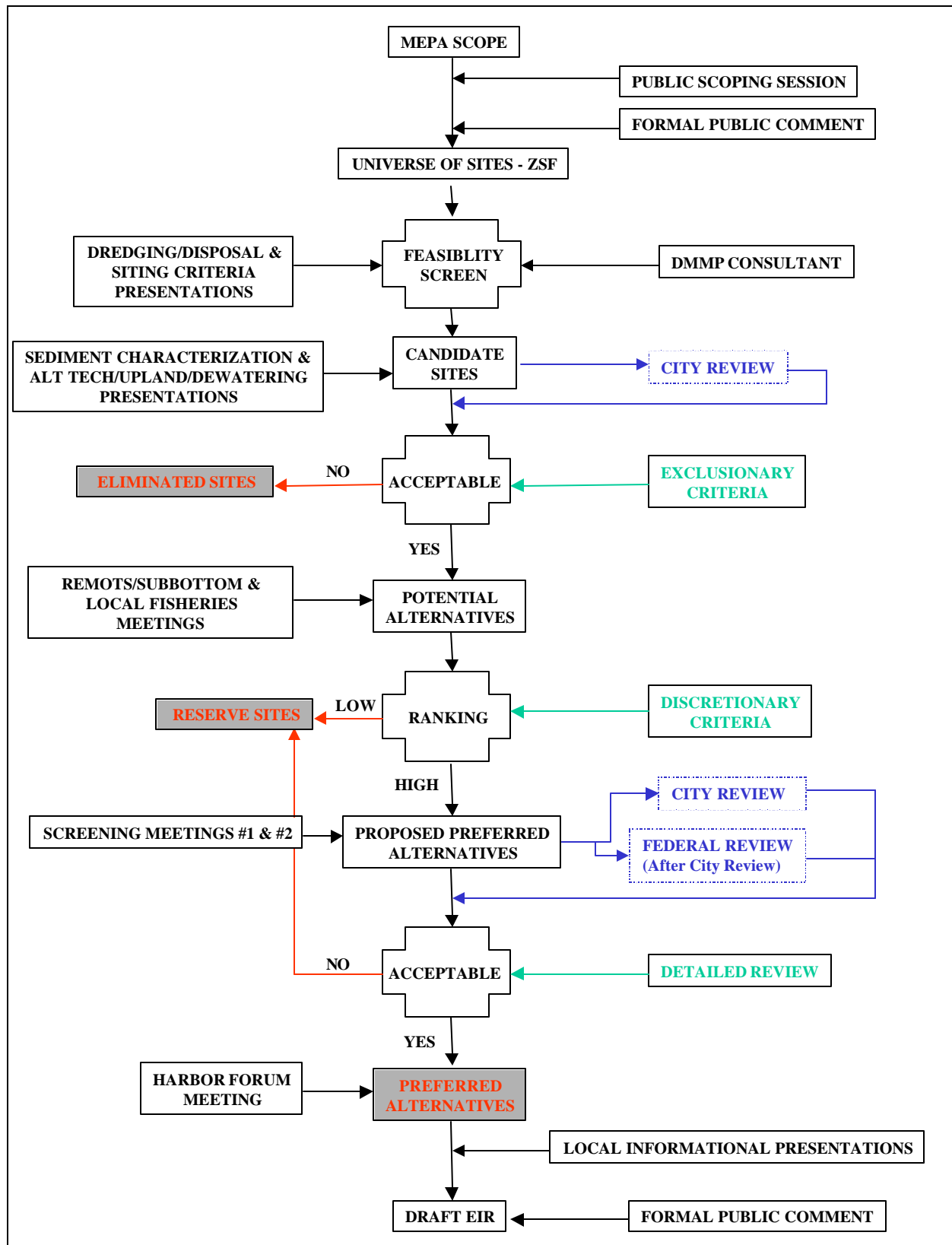


Figure 4-7: DMMP Disposal Site Screening Process



In order to facilitate involvement with the City, the Town and the Dredged Material Management Committee, and to provide a concise framework for evaluation and comparison of each disposal site, data sheets were developed which provided information from each site relative to the evaluation criteria. These data sheets were reviewed with the Committee during various phases of the screening process. Maps depicted the location of these sites and summary comparison matrices were also disseminated with the data sheets.

Sites that survived the feasibility screen, i.e. candidate sites, in addition to being presented to the City, Town and the Dredged Material Management Committee, underwent exclusionary criteria analysis. For example, sites that were located in areas inhabited by federally or state-designated endangered species were eliminated from further consideration. In some cases, such as for the upland disposal analysis, exclusionary criteria significantly reduced the number of sites for further study. In other cases, such as for the aquatic disposal analysis, exclusionary criteria had no effect on the screening process. Where it was deemed useful and practicable, such as with the candidate aquatic sites, site-specific field investigation was conducted to better characterize and distinguish the sites. Those sites that survived this screen were deemed potential alternatives.

A series of discretionary criteria were applied to each of the potential alternatives. Each potential site was evaluated with respect to these criteria and the result was a ranking of sites. At this stage in the process, each of the sites had potential as a dredged material disposal site but some sites had attributes that clearly distinguished them from the other sites. These “higher ranking” sites were then elevated to “proposed preferred” status. These sites, and the process whereby they were selected, were presented to the City, Town and federal resource agencies for review. These sites also underwent more detailed field analysis and the result was the selection of a preferred alternative, which is the alternative that is evaluated for environmental impacts in Section 6.0 of this DEIR.

The following sections of this DEIR are divided to correspond with the four categories of disposal alternatives considered for the New Bedford/Fairhaven Harbor DMMP. Sections 4.5 through 4.8, describe the procedures, screening criteria and results of alternative treatment technology, dewatering, upland and aquatic disposal siting analyses.

## 4.5 Alternative Treatment Technology Alternatives

This section describes the available alternative technologies for treatment of UDM, the process for evaluating these technologies, the factors used in the evaluation, and the results of this evaluation with respect to applicability to the New Bedford/Fairhaven DMMP. As discussed in Section 3.0, sediments tested and determined to be unsuitable for open ocean disposal, contain primarily metals and PAHs that exceed MBDS reference values. Alternative treatment technologies were evaluated in the context of their ability to ‘treat’ these constituents of the New Bedford/Fairhaven Harbor UDM.

### 4.5.1 Screening Process

Alternative treatment technologies and their applicability to the DMMP were evaluated in Phase 1 of the DMMP (Maguire 1997a) and updated in this DEIR.

Data on the technologies were gathered from several sources including the USEPA, US Department of Defense, USACE, Environment Canada, and technology vendors. In addition, the findings of other dredging projects involving contaminated sediments were reviewed including the New Bedford Superfund studies, BHNIP various projects conducted by the Port Authority of New York and New Jersey, Boston Harbor projects, and several projects in European countries.

The inventory included technology description, treatment cost, and site demonstration information for 14 classes of treatment technologies including: chelation, chemical reduction/oxidation, dehalogenation, fungal remediation, incineration, in-situ bioremediation, pyrolysis, slurry bioreactor, solid-phase bioremediation, solidification/stabilization, solvent extraction, thermal desorption, and vitrification (see Appendix D). An overview of pretreatment, sidestream treatment, and residuals management options was also presented.

As part of this technology assessment, a survey of vendors was conducted to gather current information in several major comparative categories including: ability to treat various contaminant types, effects of sediment characteristics on the treatment process, potential role of the vendor in a sediment decontamination project, capabilities and logistical requirements of the process equipment, and information on current and projected costs. The results of the vendor survey allowed for a comparative evaluation of the technologies using standard criteria.

Regulations governing the recycling or reuse of treated sediment have yet to be promulgated in Massachusetts. The DEP is currently developing a Comprehensive Dredging Regulation and a set of regulations/policies/procedures for the management of non-municipal-solid-waste contaminated media, both targeted for completion in 2002. Currently, proposals for reuse and alternative treatment technologies are evaluated under 310 CMR 16.00 and 19.00 (Appendix J). A Beneficial Use Determination (BUD) process (Figure 4-8) as described in 310 CMR 19.060 determines the acceptability of treating contaminated media (including sediments). A Demonstration of Need (DON) for the treated product may also be needed to get approval from DEP (Figure 4-9). BUD and DON are currently two separate processes. BUD is the main permitting process for the use and distribution of the material.

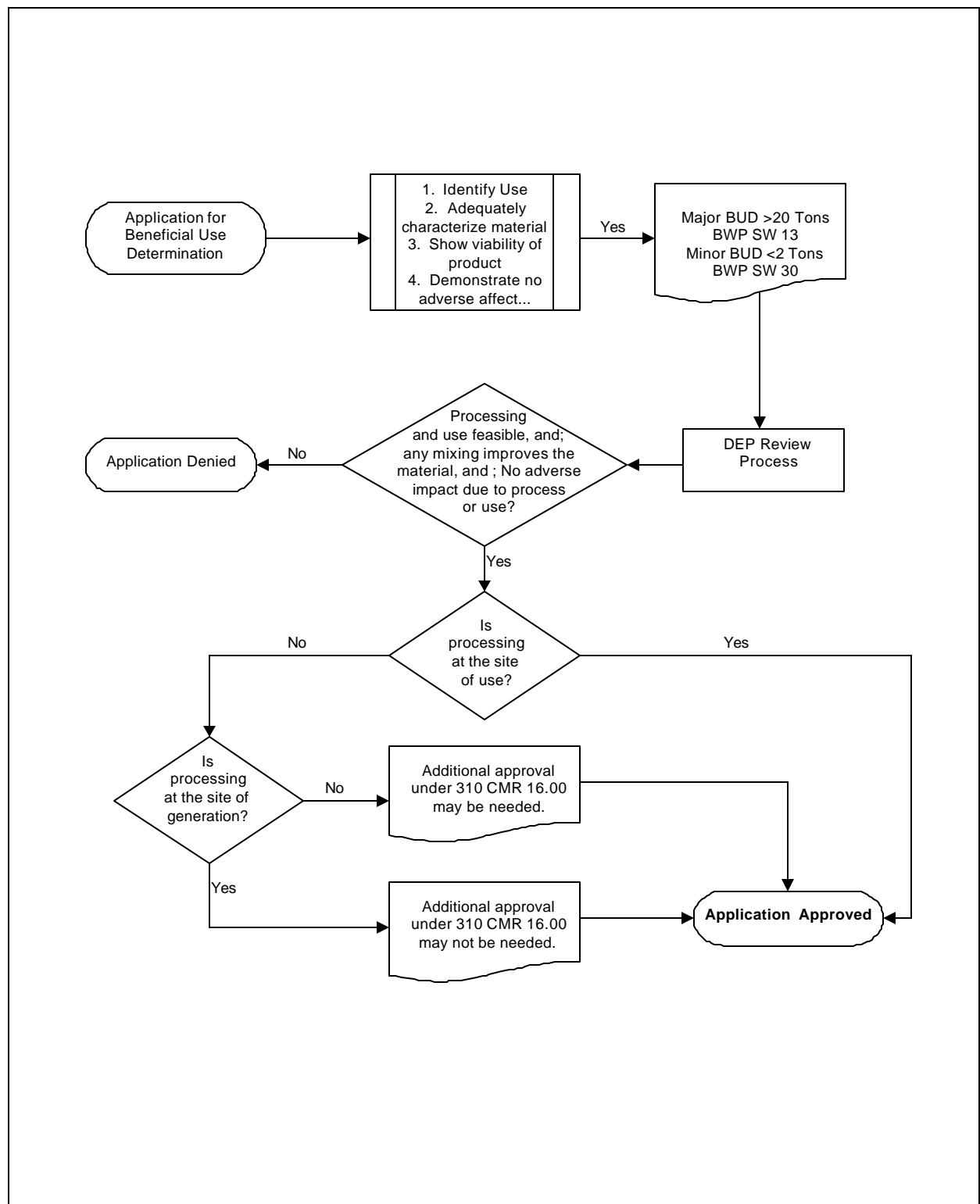
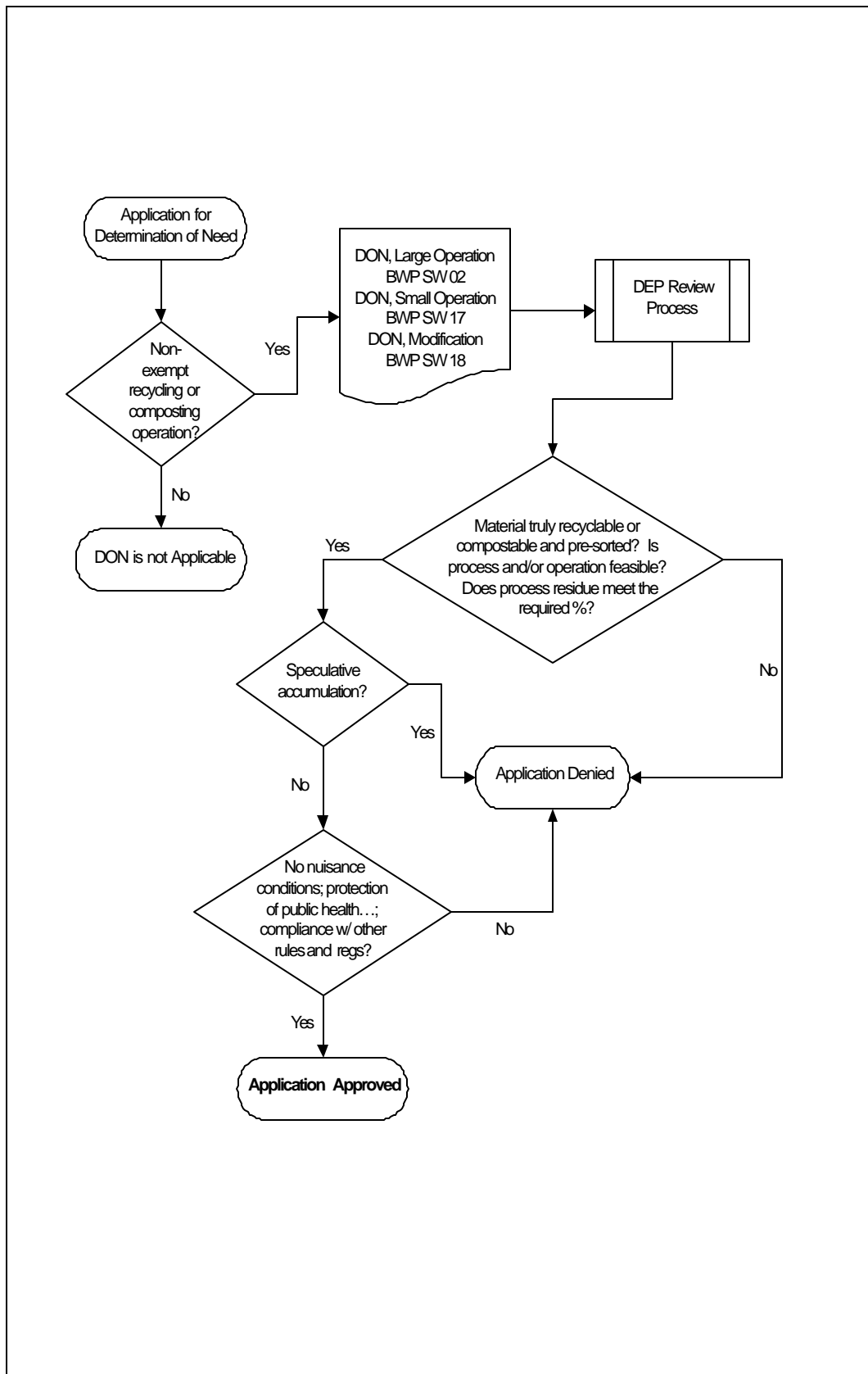


Figure 4-8: Beneficial Use Determination Process

**Figure 4-9:** Determination of Need Process

The UDM that is treated must have a beneficial end use in order for approval to be granted. The product must be viable, i.e. there must be a practical and marketable use. Also, the product and the treatment process itself must be demonstrated to have no adverse effect on the environment.

### ***4.5.2 Description of Treatment Technologies***

This section describes existing sediment decontamination technologies. For each technology, distinct categories of the sediment decontamination process including: pretreatment technologies, treatment technologies, sidestream treatment technologies, and residuals management are also considered.

*Pretreatment* of the sediment typically involves removal of oversized materials and dewatering prior to treating the contaminated sediment.

*Treatment* of the sediment involves application of the primary decontamination process (e.g., physical, chemical, biological, and/or thermal) to reduce, destroy, or immobilize the target contaminants present in the sediments. Treatment may include use of a single technology or use of multiple technologies (i.e., treatment “train” or sequence) in order to address the widely-varying contamination and sediment types.

*Sidestream treatment* is often required for sidestream wastes (e.g., offgas, particulate emissions, and wastewater) generated during the primary sediment treatment process. These sidestream wastes typically require special handling, treatment, and/or disposal.

*Residuals management* involves the handling of treated solids from the primary sediment treatment process that may be acceptable for reuse or contain residual contamination which warrants special disposal.

The capabilities and costs of the treatment technology are the main consideration in the selection of a sediment decontamination method. Because sediments often contain a mixture of contaminants, the ability of a treatment technology to handle widely-varying contaminant and sediment types is very important. There are many technologies that will treat a specific contaminant in a relatively inexpensive manner, but require the addition of other technologies in a treatment train to handle a range of contaminants. Use of a treatment train increases the costs, handling requirements, potential environmental exposure, and complexity of sediment decontamination. On the other hand, some individual technologies may be more expensive, but can treat a full range of contaminants. Although the treatment process normally represents the major portion of the costs of sediment decontamination, the total costs including pretreatment, sidestream treatment, and residuals management must be considered when choosing between treatment alternatives. Public concerns about sidestream discharges, especially air emissions, can preclude the selection of certain treatment technologies. As mentioned in Section 2.1, the treatment technology information contained in this section was gathered from previously-published sources. All data on costs, treatment efficiencies, and reference sites were taken from the SEDTEC (Environment Canada, 1996) and VISITT (EPA, 1996) databases. For those technologies without costs or reference sites, no datum was available in VISITT or SEDTEC.

**Table 4-2:** Cost and Production Rates of Treatment Technologies

<b>Technology</b>	<b>Treatment Rate (tons/hr)</b>	<b>Average Cost (per cubic yard)</b>	<b># Technologies per Category</b>
Chelation	16	\$83	1
Chemical Reduction/Oxidation	172	\$232	8
Dehalogenation	76	\$263	15
Fungal Remediation	ND	\$215	2
Incineration	10	\$243	8
In-Situ Bioremediation	135	\$42	22
Pyrolysis	9	\$262	3
Slurry Bioreactor	17	\$223	12
Soil Washing	32	\$89	19
Solid-Phase Bioremediation	62	\$62	51
Landfarming	ND	\$48	2
Composting	40	\$73	7
In-Vessel Bioremediation	1	\$154	3
Solidification/Stabilization	40	\$99	1
Thermal Desorption	27	\$177	52
Vitrification	3	\$462	17
Solvent Extraction	37	\$182	21

ND = Not enough data

Source: SEDTEC 1996 and EPA 1996

Table 4-2 presents average values of the treatment rates and costs for the treatment technologies described in this section as well as the total number of vendors for each technology listed in the SEDTEC and VISITT databases. The average treatment costs range from \$4/cy for phytoremediation to \$462/cy for vitrification. The average cost for all of the technologies considered was \$179/cy. These costs are strictly for comparative use and should be considered preliminary estimates only. Costs are subject to high variability based on the uncertainties associated with the widely-varying contaminant and sediment types, concentrations, and site-specific conditions.

#### 4.5.2.1 Chelation

This process is a form of chemical stabilization that immobilizes metals. Chelation, or complexation, is the process of forming a stable bond or complex between a metal cation and a ligand (chelating agent). Chelating agents, or ligands, may form a single bond (monodentate) or multiple bonds (polydentate) with the target cation. The more bonds formed, the more stable the resulting complex and the greater degree of immobilization of the metal contaminant within the complex. Ethylenediaminetetraacetic acid (EDTA) is a commonly used polydentate chelating agent. Process efficiency is ion-specific depending upon the chelating agent, pH, and dosage.

The chelation process for metal immobilization may reduce the leachable metals adequately to meet the toxicity characteristic leaching procedure (TCLP) requirements. Treated sediments are the only residuals generated by the chelation process. Sidestream waste includes wastewater from dewatering of the treated sediments. Costs given by the vendor listed for chelation treatment are \$83/cy.

#### 4.5.2.2 Chemical Reduction/Oxidation

Chemical Reduction/Oxidation technology uses chemical additives to detoxify target contaminants by conversion into less toxic or immobile forms. Chemical oxidation processes work by transferring electrons from the contaminant to the oxidizing agent, which is reduced. Typical oxidizing agents include various forms of chlorine, potassium permanganate, hydrogen peroxide, persulfate, and ozone. These chemical oxidants may be catalyzed by the ultraviolet radiation or other transitional metal additives to enhance its oxidation potential by generation of free radicals.

Typical treatment efficiencies for selected organics may attain 90 to 95% removal. Sediment residuals contain excess chemical agents, reaction by-products including dissolved gases may require a post-treatment monitoring prior to backfill. Sidestream wastes include wastewater from dewatering of the treated sediments and offgas from the treatment vessel. Wastewater can be recycled into the extraction process. Costs for reduction/oxidation treatment range from \$39 to \$2,805 per cubic yard (\$35 to \$2,550 per ton) with an average cost of \$232 per cubic yard (\$211 per ton) (neglecting the highest value). In Europe, reduction/oxidation is only used as part of a soil washing train, after removal of fine particles.

Limitations include:

- Incomplete oxidation may lead to the formation of intermediate contaminants that are more toxic than the original;
- Dewatering is required after treatment;
- High organic content increases the required reagent dosage;
- Potential foaming and gas emissions of treated products; and,
- Presence of non-target compounds may react with the reagent additives to increase the treatment cost.

#### 4.5.2.3 Dehalogenation

Dehalogenation is a process which destroys or removes some of the halogen atoms from halogenated aromatic compounds such as polychlorinated biphenyls (PCBs), dioxins, furans, and pesticides by substitution of bicarbonate or glycol for the halogen (usually chlorine) atoms. The two most common forms of dehalogenation are base-catalyzed decomposition and glycolate dehalogenation. Costs for dehalogenation range from \$220 to \$330 per cubic yard with an average of \$263 per cubic yard.

#### 4.5.2.4 Fungal Remediation

Fungal remediation is a particular subset of bioremediation that employs fungi rather than bacteria to degrade the contaminant. White rot fungus is the most commonly studied fungus because the enzymes secreted by the white rot fungus can degrade lignin, the complex organic building block of wood. White rot fungus has shown the ability to destroy complex organic compounds such as explosives, pesticides, PAHs, and PCBs. Although the potential of white rot fungus has been known for over 20 years, there have been few commercial applications of this remedial technology.

Treatment efficiencies of approximately 50% have been reported. Costs for the two vendors offering fungal remediation are \$165 to \$264 per cubic yard. Residuals include the treated sediments. No sidestream wastes are generated during this treatment process.

Limitations include:

- High contaminant concentrations may be toxic to the fungus;
- Minimum degradation concentration of contaminants may not meet the cleanup standard;
- Does not treat metals;
- Unknown how salt water will effect white rot fungus;
- Short life of cultured fungi may require frequent reactor replacement; and,
- Removal efficiencies of approximately 50% are considered too low to effectively treat contaminated sediments.

#### 4.5.2.5 Incineration

Incineration is one of the most commonly-used remediation technologies. Incineration, or thermal oxidation, destroys contaminants using high temperatures in the presence of oxygen and is effective in destroying a wide range of organic contaminants. Currently in Massachusetts, incineration of wastes is not looked on favorably by the DEP, environmental groups, or the public. It would be very difficult to site an incineration facility in Massachusetts as evidenced by recent efforts to site a portable thermal oxidizer for treatment of 30,000 cy of soil near Logan Airport. Other efforts, such as the proposed incineration of PCB-laden sediments from New Bedford Harbor in the early 1990s were also thwarted due to potential air quality impacts. Treatment efficiency of the incineration process generally exceeds 99.99% and can be as high as 99.9999% when required for PCBs and dioxin. Costs for incineration range from \$55 to \$880 per cubic yard with an average cost of \$243 per cubic yard. Incineration costs increase for PCBs and dioxins.



Limitations include:

- Requires a very low moisture content in sediments;
- Strict feedstock particle size limitations (1 - 2 inches maximum);
- Gaseous discharges are a major potential contaminant emission pathway;
- Heavy metals are not removed or destroyed and are more leachable after incineration;
- Metals can react with chlorine or sulfur to form more toxic compounds;
- Public opposition;
- Permitting difficulties; and,
- Large area required for equipment layout.

### 4.5.2.6 In-situ Bioremediation

In-situ bioremediation is a process in which indigenous or inoculated microorganisms (i.e., fungi, protozoa, bacteria, and other microbes) degrade organic contaminants found in the sediments. In the presence of sufficient oxygen, microorganisms may ultimately convert many organic contaminants to carbon dioxide, water, and microbial cell mass. In the absence of oxygen, the contaminants may be ultimately reduced to methane, carbon dioxide, and trace amounts of hydrogen gas. Sometimes contaminants may be degraded to intermediate products that may be equally, or more hazardous than the original contaminant. In-situ bioremediation processes have been successfully used to treat petroleum hydrocarbons, solvents, pesticides, and other organic chemicals.

Treatment efficiency of the in-situ bioremediation process generally exceeds 90% and can be as high as 99%. Costs for in-situ bioremediation range from \$6 to \$116 per cubic yard with an average cost of \$42 per cubic yard.

Limitations include:

- Extended remediation times on the order of years to decades;
- High concentrations of heavy metals and contaminants may be toxic to microorganisms;
- Bioremediation slows at low temperatures;
- Not all organic compounds are biodegradable;
- Bioremediation rates are limited by the availability of PAHs, PCBs and pesticides in the sediments; and,
- Heterogenous geological conditions and low permeability soils (less than  $10^{-5}$  cm/sec) are not favorable for in-situ bioremediation.

### 4.5.2.7 Pyrolysis

Pyrolysis involves the destruction of organic material in the absence of oxygen. The absence of oxygen allows separation of the waste into an organic fraction (gas) and an inorganic fraction (salts, metals, particulates) as char material. Pyrolysis is normally used to treat high levels of organics (e.g., semivolatile organic compounds and pesticides) that are not conducive to conventional incineration.

Treatment efficiency for the pyrolysis technology generally exceeds 99%. Costs for the two vendors offering pyrolysis are \$248 and \$275 per cubic yard. Major factors affecting this estimate are the condition and properties of the feed sediment (i.e., moisture, total contamination, and soil characterization).

Limitations include:

- Requires a very low moisture content (<1%) in sediments;
- Strict feedstock particle size limitations;
- Gaseous discharges are a major potential contaminant emission pathway;
- Heavy metals are not removed or destroyed, but are not more leachable after pyrolysis;
- Public opposition;
- Permitting difficulties; and,
- Site space limitations.

#### 4.5.2.8 Slurry Bioreactor

A slurry bioreactor is a controlled biological treatment vessel where the contaminated sediments are treated in a slurry form at a low solids content. The sediment is mixed with water to a predetermined concentration dependent upon the concentration of the contaminants, the rate of biodegradation, and the physical nature of the sediments. Slurry bioreactors can treat a variety of organic contaminants including chlorinated and non-chlorinated volatile organics, PAHs, PCBs, and pesticides.

Typical treatment efficiencies of greater than 90% can be attained in a slurry bioreactor. Treatment costs range from \$6 to \$825 per cubic yard with an average cost of \$223 per cubic yard. Treatment residuals include processed soils. Sidestream wastes include wastewater from dewatering the treated slurry and offgas from the treatment vessel.

Limitations include:

- Heavy metals at high concentrations can inhibit microbial degradation;
- Treatment and disposal of wastewater from slurry dewatering;
- Dewatering is required after treatment;
- Equipment operation and maintenance is intensive;
- Higher energy costs than solid-phase bioremediation;
- Organic destruction efficiencies are generally low at low concentrations; and,
- Low cleanup standards may be difficult to meet for recalcitrant organics.

#### 4.5.2.9 Soil Washing

Soil washing refers to the process of using water to physically separate the sediments by particle size into a reusable bulk fraction and a smaller fraction containing concentrated contaminants. Since organic contaminants are often sorbed to the finer silt and clay particles, separation of this fine fraction from the sandy sediments allows reuse of the typically non-contaminated sands and accomplishes a volume reduction of the total contaminated sediment mass. It is also possible to add chelating agents, surfactants, acids, or bases to separate the contaminants from the sediment. Soil washing has the potential to treat a variety of contaminants including PAHs, PCBs, fuel oil, heavy metals, radionuclides, and pesticides.

Typical treatment efficiencies are greater than 90% for volatile organics, 70 to 95% for metals, and 40% to 90% for semivolatile organics. The cost of soil washing ranges from \$20 to \$220 per cubic yard with an average cost of \$89 per cubic yard.

Limitations include:

- Soil washing is only marginally effective for sediments composed primarily of clays and silts;
- Maximum particle size typically 0.5 cm;
- Removal of fines from wastewater may require the addition of polymer flocculent;
- Treatment and disposal of wastewater from dewatering; and,
- Dewatering is required after treatment.

### 4.5.2.10      Solid-Phase Bioremediation

Biological degradation of contaminants is a naturally-occurring process. Bioremediation is the acceleration of the natural biodegradation processes by controlling moisture content, temperature, nutrients, oxygen, and pH to create the optimal environment. For purposes of this discussion, the varieties of solid-phase biological treatment processes have been divided into three categories based on level of engineering: landfarming, composting, and in-vessel bioremediation. Solid-phase biological treatment technologies are used primarily to treat VOCs and petroleum hydrocarbons. It is also possible to treat PAHs, PCBs, halogenated organic compounds, explosives and pesticides to some degree, especially in the more highly-engineered in-vessel systems.

Costs for all solid-phase bioremediation technologies range from \$3 to \$264 per cubic yard with an average cost of \$62 per cubic yard. Solid-phase bioremediation is used on a production scale in Europe, especially in The Netherlands, Germany, and France.

### 4.5.2.11      Landfarming

Landfarming is the least engineered of the solid-phase bioremediation treatment processes. Landfarming consists of spreading the contaminated sediments over a large area of land and periodically tilling the sediments for aeration. Environmental conditions are controlled by watering (moisture content), fertilizing (nutrient concentration), tilling (oxygen concentration), and lime addition (pH) to accelerate natural bioremediation. Temperature cannot be regulated to a great extent, limiting the applicability of landfarming in cold climates. Since oxygen is added by tilling, the thickness of the spread contaminated sediments is limited to the tilling depth; therefore, a large area of land is required for landfarming. Landfarming may also incorporate the use of polyethylene liners to control leaching of contaminants.

Treatment efficiencies are highly variable but generally greater than 90% for contaminants amenable to aerobic bioremediation. The effectiveness in remediating petroleum hydrocarbons has been widely demonstrated. The costs for the two vendors offering landfarming are \$44 and \$52 per cubic yard.

Limitations of Landfarming include:

- Open landfarming may not be practical in regions of heavy annual rainfall precipitation and/or cold climate;
- Does not remediate inorganic contaminants;
- Inorganic contaminants may leach from contaminated sediments into ground;
- Ineffective for treatment of high molecular weight PAHs and highly chlorinated PCBs;
- Can generate odors;
- Of the solid-phase bioremediation treatment processes, landfarming offers the least control over environmental conditions;
- Of the solid-phase bioremediation treatment processes, landfarming offers the least control over collection of offgas;
- Of the solid-phase bioremediation treatment processes, landfarming requires the largest space; and,
- Of the solid-phase bioremediation treatment processes, landfarming requires the longest cleanup time.

#### 4.5.2.12 Composting

Composting is the middle level of the engineering hierarchy of the solid-phase bioremediation treatment processes. The two major variations of the composting process discussed here are windrow and aerated static pile. The windrow is a pile typically 6-10 feet high, 15-20 feet wide and hundreds of feet long. Windrows are mechanically turned twice a week to once a year to aerate the pile, control the temperature, and create a more uniformly mixed material. Turning of the pile releases odors. Composting is completed in one month to a few years depending on the contaminants and the level of maintenance of the windrow.

Treatment efficiencies are highly variable but generally greater than 90% for contaminants amenable to aerobic bioremediation. The cost of composting ranges from \$25 to \$198 per cubic yard with an average cost of \$73 per cubic yard.

Limitations of composting include:

- A large space is required;
- Questionable effectiveness for treatment of high molecular weight PAHs and highly chlorinated PCBs;
- Requires months of cleanup time;
- Can generate odors; and,
- Collection of offgas is difficult.

#### 4.5.2.13 In-Vessel Bioremediation

In-vessel bioremediation is the most engineered of the solid-phase bioremediation treatment processes. In-vessel biological treatment is often referred to as in-vessel composting. Here it is discussed separately since it is possible to have anaerobic conditions. Treatment consists of placing the contaminated sediment mixture in engineered treatment enclosures with leachate collection systems and aeration equipment. In-vessel composting is completed in a couple of weeks and the pile is normally allowed to cure for an additional one to three months. In-vessel systems allow stricter environmental controls, faster composting

times, odor collection and treatment, smaller area requirements, and can handle a wider variety of contaminants.

Typical treatment efficiencies range from 70 to 95%. Typical costs range from \$33 to \$220 per cubic yard (\$30 to \$200 per ton) with an median cost of \$154 per cubic yard.

Limitations of In-Vessel Bioremediation include:

- Ineffective for remediating inorganic contaminants;
- Difficult to treat high molecular weight PAHs and highly chlorinated PCBs;
- Most expensive of the solid-phase bioremediation treatment processes; and,
- Emission controls for offgas may be required.

### 4.5.2.14 Solidification/Stabilization

Solidification/stabilization is effective at immobilizing contaminants and are among the most commonly used remediation technologies. Solidification/stabilization involves mixing reactive material with contaminated sediments to immobilize the contaminants. Contaminants are physically bound or enclosed within a stabilized mass (solidification), or undergo chemical reactions with the stabilizing agent to reduce their mobility (stabilization). Binding of the contaminants to the sediment reduces contaminant mobility via the leaching pathway. A typical treatment process includes homogenization of the feed material followed by mixing of solid or liquid reagents with the feed material in a pug mill. Three specific categories examined in this screening include asphalt, cement, and lime solidification/stabilization.

Solidification is the process of eliminating the free water in a semisolid by hydration with a setting agent or binder. Typical binder materials include cements, kiln dust, and pozzolans such as lime/fly ash. Binders used in Germany and France are bentonite and Portland cement. Solidification usually provides physical stabilization but not necessarily chemical stabilization. Physical stabilization refers to improved engineering properties such as bearing capacity, trafficability, and permeability. Although solidification/stabilization technologies are not generally applied to organic contaminants, physical stabilization can also immobilize contaminants since the contaminants tend to be bound to the fines, which are physically bound in the solidified matrix. Chemical stabilization is the alteration of the chemical form of the contaminants to make them resistant to aqueous leaching. The solubility of metals is reduced by formation of metal complexes, chelation bonds, or crystalline precipitates within the solid matrix with chemical additives and by controlling pH and alkalinity. Anions, which are more difficult to bind as insoluble compounds, may be immobilized by entrapment or microencapsulation. Chemical stabilization of organic compounds is not very reliable.

Results of reactions of binders to the contaminated sediment are not always predictable due to varying contaminant types and concentrations within the test material. Therefore, laboratory leach tests must be conducted on a sediment-specific basis.

#### *Asphalt Batching*

Asphalt batching is a commonly used technology in Massachusetts and has been proven effective in immobilizing TPH, VOC, and PAH compounds. Contaminated solids are blended with asphalt emulsions in a pug mill. The asphalt-emulsion-coated material is stockpiled and allowed to cure for approximately

2 weeks. Pretreatment requirements include dewatering and size classification by screening or crushing to less than 3-inch diameter. End product can be recycled as a stabilized base material for parking lots or roadways.

#### *Cement Solidification/Stabilization*

Cement solidification/stabilization involves mixing the contaminated sediments with Portland cement and other additives to form a solid block of stabilized waste material with high structural integrity. Siliceous materials such as fly ash may be added to stabilize a wider range of contaminants than cement alone. Cement solidification/stabilization is most effective for inorganic and metallic contaminants.

#### *Lime Stabilization*

Lime/fly ash pozzolanic processes combine the properties of lime and fly ash to produce low-strength cementation. Lime stabilization involves mixing the contaminated sediments with lime in a sufficient quantity to raise the pH to 12 or higher. Raising the pH results in chemical oxidation of the organic matter, destruction of bacteria, and reduction of odor. Lime stabilization is commonly used to treat wastewater sludge and is primarily effective for organic contaminants and microbial pathogens.

Typical treatment efficiency of the solidification/stabilization process ranges from 75% to 90%. Costs range from \$48 to \$330 per cubic yard with an average cost of \$99 per cubic yard. Residuals produced from treatment are stabilized blocks of sediment material. Air emissions are the main sidestream waste produced during the treatment operation

Limitations include:

- May not be particularly effective for organic contaminants, particularly VOCs;
- Fine particles may bind to larger particles preventing effective bonding of the binder material;
- Inorganic salts may affect curing rates and reduce strength of stabilized product;
- Organic contaminants may volatilize due to heat generated during the reaction; and,
- High moisture content requires increased amounts of reagent.

#### 4.5.2.15 Solvent Extraction

Solvent extraction is similar to soil washing in that the technology produces a volume reduction of the total contaminated material, however, solvent extraction focuses on extracting the contaminants from the sediments using organic solvents. Contaminated material volume reductions of 20 times or more are attainable. Solvent extraction is targeted primarily at organic contaminants including PCBs, PAHs, VOCs, petroleum hydrocarbons, and chlorinated solvents. This technology is not particularly applicable to inorganics; however, organically-bound metals can be extracted.

Treatment efficiencies for the solvent extraction process generally exceed 90% and are typically in the 98-99% range. The costs ranges from \$21 to \$567 per cubic yard with an average cost of \$182 per cubic yard.

Limitations include:

- Less effective for sediments composed primarily of clays and silts;

- Not typically effective for removal of inorganic compounds;
- Treated soil may contain residual concentrations of solvent;
- Maximum particle size 0.5 cm;
- Treatment and disposal of wastewater from dewatering; and,
- Dewatering is required after treatment.

### 4.5.2.16 Thermal Desorption

The thermal desorption technology employs high temperature to volatilize organic contaminants. Thermal desorption technologies are divided into high temperature and low temperature categories. Thermal desorption is a removal process that applies to contaminants that are volatile at the process operating temperatures. Primary targets of treatment are organic contaminants including PAHs, VOCs, pesticides, and chlorinated solvents. This technology is not applicable to inorganic compounds; however, volatile metals, such as mercury, can be extracted.

#### *High-Temperature Thermal Desorption*

The high-temperature process uses temperatures between 600 °F and 1,000 °F. At these temperatures, a greater range of contaminants are volatilized including some metals (which may not be desirable).

#### *Low-Temperature Thermal Desorption*

The low-temperature process uses temperatures between 200 °F and 600 °F. The lower temperatures do not volatilize metals. Most commercial low-temperature thermal desorption units are of the rotary dryer or thermal screw design. Costs for thermal desorption range from \$11 to \$908 per cubic yard with an average cost of \$177 per cubic yard.

Limitations include:

- Optimal moisture content less than 60%;
- Gaseous discharges are a major potential contaminant emission pathway;
- Feedstock particle size limited to 2 inches maximum;
- Tightly bound contaminants in clayey and silty sediments increase residence time requirements; and,
- Heavy metals are not removed or destroyed

### 4.5.2.17 Vittrification

Vitrification technology uses high temperatures, above 2,900 °F, to melt and convert contaminated sediments into oxide glasses, thus achieving destruction of organic contaminants and stabilization of inorganic contaminants. The resulting glass is nontoxic and suitable for landfilling as non-hazardous materials. Vitrification technology is applicable to all types of contaminants. Vitrification immobilizes inorganic contaminants in a solidified glass matrix and destroys organic contaminants with the high temperature involved in glass production.

The treatment efficiencies range approach 99% or greater for most target contaminants. Vitrification is

one of the most expensive technologies; however, since vitrification can act as a stand-alone technology, the cost of vitrification can compete when a treatment train of other technologies is required. The cost of vitrification ranges from \$66 to \$1540 per cubic yard with an average cost of \$462 per cubic yard.

Limitations include:

- Gaseous discharges are a major potential contaminant emission pathway;
- Creates a glass material that must be reused or disposed;
- More expensive than incineration; and,
- Molten product requires long cooling period.

### ***4.5.3 Screening Factors***

To evaluate alternative sediment decontamination technologies, a survey was performed of potential vendors of treatment systems. Potential vendors were identified from the VISITT and SEDTEC databases. Each vendor was provided with a sediment decontamination technology vendor questionnaire to complete either on-line or through the mail. A copy of the questionnaire is provided in Appendix D. The questionnaire was developed and administered in order to obtain information for a comparative analysis of treatment technologies. Results of this questionnaire allowed development of a consistent set of results including site conditions, sediment characteristics, target cleanup levels, treatment options, and cost elements to evaluate sediment decontamination processes and vendors.

The vendor questionnaire was divided into several major comparative categories including: Business Information, Ability to Treat, Effects of Sediment Characteristics, Vendor Involvement, Process Information, and Cost. These elements, as well as several practicability criteria were applied to each technology. In addition, DEP Solid Waste Management staff were consulted regarding specific case-studies and experience in the application of alternative treatment technologies to dredged material and other media within the Commonwealth (see Appendix K for DEP comments and Section 4.5.4 below for detailed screening).

#### **4.5.3.1 Ability to Treat**

The ability of the technology to treat the contaminants that may potentially be present in the dredged sediments such as metals, PAHs, PCBs, and TPH is a primary consideration in evaluating treatment technologies. The vendor was asked to categorize their technology for its ability to provide immobilization, removal, destruction, or no effect on the target contaminants. In addition, the typical treatment efficiencies and operating ranges (i.e., low and high contaminant levels) were to be identified. Specific individual contaminant exceptions within each of the four major contaminant groups were also to be identified in this section.



### 4.5.3.2 Effects of Sediment Characteristics

This category contains information about the sensitivity of the treatment technology to variations in the physical and chemical properties and characteristics of the dredged sediments. Requested information included the maximum particle size accepted by the treatment system and the optimal solids content recommended for the treatment system by the vendor. More detailed information was requested on the effects of specific sediment characteristics on the treatment technology. These characteristics included sandy, silty, clayey, low and high moisture content, low and high organic content, and high metals content. Choices provided for describing the effects of the sediment characteristics on the treatment technology included favorable, no effect, impedes, or unknown.

### 4.5.3.3 Process Information

This category contains information specific to the design and implementation of the vendor's technology. The most critical piece of information in this category is the current scale of development of the technology. Choices included laboratory, pilot, or full/commercial scale. The total number and site-specific references were requested of those vendors with full scale operations. Process-specific information requested included pretreatment requirements, treatment batch size and treatment time, maximum system throughput, residuals generated (e.g., liquid, solid, gas, none), and residual disposal requirements. In addition, any special site- or process-specific needs such as power, water, safety, or permits were to be identified in this section. Other process-specific information included mobilization and demobilization times and layout space required.

### 4.5.3.4 Cost

The capabilities and costs of the treatment technology, in combination with the time required to process a given volume of sediment (see throughput below), are a key consideration in the selection of a sediment decontamination method. The cost of sediment decontamination technologies is relatively high ranging from \$70 to \$170 per cubic yard. In comparison, contaminated sediments from the BHNIP will be disposed of in CAD cells within the footprint of the area to be dredged at an estimated disposal cost of \$36 per cubic yard.

### 4.5.3.5 Throughput

The vendor survey found that the treatment technologies generally have low throughput ranging from 30 to 2,000 cy per day. The treatment technologies evaluated for the BHNIP were rejected partially because the low throughput would constrain the viability of the project. Throughput rates must be considered along with the number of days allowed for dredging and the volume of material to be dredged. In New Bedford/Fairhaven Harbor, dredging is allowed only in the late fall and winter months to protect sensitive spawning activities. There are approximately 100 working days (Monday through Friday) in any one dredging season. For a project of 100,000 cy, 1,000 cy of sediment would need to be dredged each day. For smaller projects, slower throughput rates could be adequate, but for large projects, dredging rates of 5,000 - 10,000 cy per day are typical.

Ten of vendors reported throughput rates equal to or greater than 1,000 cubic yards per day, but the majority of processes have much lower throughput rates, in the hundreds of cubic yards per day range .

#### 4.5.3.6 Demonstrated Success

The results of the vendor survey and pilot-scale testing for the Port of NY/NJ cast doubt on the assertion that technologies are not available and proven. The vendors surveyed reported an average of 32 reference sites for full-scale implementation, and approximately half of the vendors reported 5 or more full-scale implementations of their technology. However, the ability of a treatment system to handle widely-varying sediment and contaminant types remains a challenging issue.

#### 4.5.3.7 Logistics

The availability of space, utilities, time, and other logistics are site-specific issues not addressed in this report other than to mention the importance of considering such issues.

#### 4.5.3.8 Permitting Issues

Two issues make permitting of treatment facilities particularly difficult in Massachusetts: sidestreams and residuals management. Public concerns of sidestreams such as gaseous emissions can bring overwhelming opposition to the siting of a treatment facility. Residuals management is discussed separately below.

#### 4.5.3.9 Residuals Management

The costs incurred while managing residuals can easily result in a treatment option that is not economical. In the best case, the residuals can potentially have a commercial value to help offset treatment costs. Based on the documents contained in Appendix C, it appears that there is limited applicability of the following residuals management options: landfill disposal, recycling as landfill cover, and recycling as asphalt material. In addition, the uncertainties associated with the reuse option will greatly limit its applicability until regulations/policies have been promulgated. Although 88% of the vendors claimed that the treated sediments could be reused, it appears based on discussions of specifics with the vendors that many of the potential reuse options remain ideas and not reality.

### ***4.5.4 Screening Results***

The results of the alternative treatment technology inventory (presented below) were used to evaluate the potential for application of these technologies to sediments to be dredged from the New Bedford/Fairhaven Harbor.

The survey results are as follows:

- 77% of the technologies are at the full scale/commercial scale of development;
- Vendors offering full scale/commercial technologies have an average of 32 reference sites per vendor;
- Average throughput for all technologies is 754 cubic yards/day (838 tons/day);
- Average treatment costs for all technologies range from \$70 to \$167 per cubic yard; and,
- The top 4 factors affecting price are: 1) quantity of sediments, 2) moisture content, 3) target contaminant concentration, and 4) characteristics of sediments.

## SECTION 4.0 - ALTERNATIVES ANALYSIS

The following is a summary of the practicability of each technology for treating UDM from New Bedford/Fairhaven Harbor. Table 4-3 summarizes each technology with respect to the screening factors described above.

**Table 4-3:** Summary of Treatment Technology Characteristics

Technology	Major Advantages	Major Disadvantages
Chelation	relatively moderate cost; excellent for metals treatment	not effective for organics
Chemical Reduction/Oxidation	effective for most organics and inorganics	cost, ineffective for some PAHs, potential toxic residuals
Dehalogenation	excellent removal efficiency for PCBs and chlorinated pesticides	cost, ineffective for metals and PAHs
Fungal Remediation	low technology requirements	low treatment efficiencies, cost
Incineration	high treatment efficiency	permitability, air emissions, cost
In-Situ Bioremediation	high treatment efficiency, relatively low cost	long treatment time, not effective for all organics
Pyrolysis	high treatment efficiency	requires low moisture content, cost, permitability, air emissions
Slurry Bioreactor	effective for treating metals and organics, contained within vessels	cost, ineffective for some organics at low levels
Soil Washing	low technology, relatively low cost	not appropriate for silts and clays
Solid Phase Bioremediation	relatively low cost, low technology	slow process, large land area requirement
Landfarming	relatively low cost, low technology	slow process, large land area requirement, metals not treated
Composting	relatively low cost, low technology	slow process, large land area requirement, low effectiveness for PAHs
In-Vessel Bioremediation	good treatment efficiencies	not effective for inorganics or HMW PAHs, cost
Solidification/Stabilization	byproduct can be used as structural fill, relatively moderate cost, proven track-record for large UDM volumes	ineffective for some organics
Thermal Desorption	high treatment efficiency	requires low moisture content, cost, permitability, air emissions
Vitrification	high treatment efficiency	requires low moisture content, cost, permitability, air emissions
Solvent Extraction	effective in treating organics	not effective for metals, possible toxic residuals, not effective for silts/clays

#### 4.5.4.1 Chelation

This process is used mainly as a means of controlling leaching of metals but it is not particularly effective on organic compounds or dredged material consisting of silts and clays (which make up a significant portion of the sediments to be dredged from New Bedford/Fairhaven Harbor). Metals leaching, even in sediments containing relatively high metals levels, is typically not a problem in upland disposal. Also, chelation is not effective in treating organic contaminants such as PCBs and PAHs, which are prevalent in New Bedford/Fairhaven Harbor sediments. Chelation is relatively inexpensive compared to other treatment technologies (\$83/cy), but it requires extensive pretreatment and residuals management.

#### 4.5.4.2 Chemical Reduction/Oxidation

This process is effective in removing inorganics and organics that are present in dredged material. Throughput (172 tons per hour) is relatively high compared to other technologies, however, its cost is high (\$232 per cy). For example, a typical marina dredging project containing 10,000 cy of UDM would cost about \$2.3 million for treatment alone. Removal rates of 90 - 95% have been reported. Full scale operations have reported relatively low throughput rates of 200 tons/day.

#### 4.5.4.3 Dehalogenation

Dehalogenation processes are engineered to destroy or remove some of the halogen atoms from halogenated aromatic compounds such as PCBs, dioxins, furans and some pesticides, thereby rendering them less toxic. However it is ineffective in the removal of heavy metals and PAHs from the sediment and its cost is high at \$263 per cy.

#### 4.5.4.4 Fungal Remediation

This remediation process are relatively inefficient in their remediation capacity (50% removal). The process also does not treat metals and its effectiveness in salt-water media is unknown. In addition, the average cost is \$215 per cy.

#### 4.5.4.5 Incineration

Incineration is one of the most commonly-used remediation technologies, however, there are several disadvantages to this technology, particularly the air emissions generated from the process. Public opposition to incineration has been strong. A small portable thermal oxidizer was proposed to treat 30,000 cy of on-site generated soils (contaminated with petroleum products only) at an isolated area over a mile from the nearest resident near Logan Airport. Public opposition was so strong that the proposal was withdrawn. Incineration was originally proposed as the solution for remediating 10,000 cy of contaminated sediment as part of the EPA's Superfund cleanup effort in the upper harbor. This area, labeled the "hot spot operable unit" contained PCB concentrations of greater than 4,000 ppm, which is over 400 times the concentrations encountered in the federal navigation channels in the lower and outer harbors. EPA's Record of Decision (ROD) declaring that incineration was the preferred remedy for remediation of the sediments was met with significant public opposition and EPA revoked the incineration idea in favor of dredging and disposal in shoreline CDFs (EPA, 1998)

There are several technical shortcomings as well: heavy metals are not destroyed and may become more leachable after incineration; the technology is not effective on high moisture content (like sediments); and, gaseous discharges are created as a new contaminant pathway. PCB incineration can create emissions of dioxins and furans, two groups of highly toxic compounds. The cost is also high at \$243 per cy.

### 4.5.4.6 In-Situ Bioremediation

In-situ bioremediation technologies have been utilized in Massachusetts for treatment of oil and hazardous materials at contaminated upland sites and could potentially be used for contaminated sediment if the intent is to only remediate the sediments in-place. This is not the case for the DMMP as sediments need to be removed to provide safe navigation.

### 4.5.4.7 Pyrolysis

Pyrolysis is very similar to incineration discussed above, except that it is used to treat very high levels of organics that are not conducive to conventional incineration. Like incineration, low throughput rates and high unit costs as with incineration are encountered with the use of pyrolysis.

### 4.5.4.8 Slurry Bioreactor

This technology would require pre and post-treatment actions and extensive sidestream controls. Also, its effectiveness in treating low levels of organic contaminants is minimal. Treatment and disposal of wastewater from slurry dewatering is also required. The average cost of this treatment system is \$223/cy.

### 4.5.4.9 Soil Washing

Soil washing is one of the most common methods for treatment of dredged material. It has been used in the United States and is extensively used in Europe. This technology involves two main stages; particle separation, and, washing by water. Other substances such as chelating agents, acids or surfactants can be added to the process to aid in contaminant removal. Despite its real world usage for large volumes of dredged material, soil washing is not effective in treating silt and clay sediments, which comprise the majority of sediments to be dredged from New Bedford/Fairhaven Harbor. Sediments that contain a high sand fraction, such as areas of the eastern side of New Bedford/Fairhaven Harbor, could benefit from this technology, but at a cost of \$89 per cy.

### 4.5.4.10 Solid-Phase Bioremediation

This technology includes three basic categories of processes: landfarming, composting, and in-vessel bioremediation. Landfarming and composting require large areas of land to be effective, because the sediment requires thinning and spreading. Landfarming does not remediate metals and is ineffective for high molecular weight PAHs, which is one of the primary contaminant types in New Bedford/Fairhaven Harbor sediments. The same limitations are noted for composting. At an average cost of \$62/cy, this is the least complicated and least expensive of the treatment technologies.

In-vessel bioremediation is more than twice as expensive as landfarming or composting because it involves engineered treatment enclosures with leachate collection systems and aeration equipment. It too is not effective in remediating metals and is only marginally effective in treating high molecular weight PAHs.

#### 4.5.4.11 Solidification/Stabilization

Solidification is effective at immobilizing inorganic contaminants and is one of the most commonly used remediation technologies. It has been used in New Jersey at several shoreline sites including a site in Elizabeth, where the treated dredged material is being used as structural fill for a new shopping mall.

Solidification/Stabilization technologies are potentially viable, however, the end product still needs to find an acceptable disposal site. That end product can be of a significantly higher volume than the original dredged material because of bulking and the amendments (fly ash, cement, bentonite, lime) that are required to immobilize the contaminants and/or control pH, odor, and sulfide reactivity.

The effectiveness of these processes in immobilizing organic contaminants has been inconsistent (EPA, 1990). The USACE performed laboratory tests of New Bedford Harbor sediments mixed with various solidifying agents at various ratios. It was found that solidification with portland cement reduced the total leached amounts of total PCB, PCB Aroclors and most PCB congeners by factors of 10 to 100 times as compared to untreated sediment. However, leachability of metals such as copper nickel actually increased.

Solidification effectiveness was studied using PCB-contaminated sediments from the Great Lakes and was found to be ineffective in immobilizing PCBs (Garbaciak, 1994; D. Averett, communication)

Lime has been used as an additive to dredged material to control nuisance odors and sulfide reactivity in Massachusetts sediments that were dredged and then used as daily or intermediate cover at landfills. This was done on dredged sediments from the Central Artery/Tunnel project (Tanal, et. al., 1995).

Given the uncertainty of solidification/stabilization processes in immobilizing PCBs, project-specific laboratory or bench-scale tests would need to be conducted to determine the effectiveness of solidification/stabilization technologies in immobilizing contaminants. These processes are also relatively inexpensive compared to other treatment technologies. Average cost is estimated at \$99 per cy, although the unit cost at the aforementioned New Jersey mall site was \$56 per cy (P. Dunlap, personal communication). Solidification/Stabilization technologies appear to be a potentially viable treatment technologies. However, its applicability to the New Bedford/Fairhaven DMMP depends on: the sediment-specific effectiveness of contaminant immobilization; and, the demand for construction fill. Currently, there is no large-scale demand for fill material that cannot be supplied by upland sources. The costs for upland fill material are significantly less than that of solidified dredged material. If the demand for fill material increases over the next 20 years, and the supply of upland fill material decreases, then solidified/stabilized dredged material could become a marketable, cost-competitive commodity.

#### 4.5.4.12 Solvent Extraction

This technology is similar to, and could be used in conjunction with, soil washing technologies to treat contaminated sediments. However, it has a slow production rate (37 tons/hr) and is expensive (average cost \$192 per cy). Its effectiveness in treating organic contaminants such as PAHs, PCBs, petroleum

hydrocarbons and chlorinated solvents is good, but only for coarse grained materials such as sand, however the majority of sediment to be dredged from the New Bedford/Fairhaven Harbor is fine-grained (silts and clays).

This technology was evaluated as part of the Superfund remediation project in New Bedford. EPA determined that, while solvent extraction would have been an effective remedy, because it would provide the ultimate destruction of PCBs, its reliability and potential lack of qualified vendors were reasons why it was dismissed as the preferred alternative (EPA, 1990).

### 4.5.4.13 Thermal Desorption

Thermal desorption is very similar to incineration and pyrolysis and has many of the same characteristics. That is it has a low throughput rate (27 tons/hr) and high cost (\$177/cy) for operation. This technology is not effective in destroying inorganics, such as metals. Off-gas from the process needs to be treated before release to the atmosphere.

### 4.5.4.14 Vitrification

Vitrification is the most effective treatment system available for treating a media that contains a wide variety of contaminants, such as dredged material. Through exposure to 2,900°F heat, the soil/sediment is melted and converted into an oxide glass-like slag that would be suitable for landfilling. Vitrification, however, is one of the most expensive treatment technologies at an average cost of \$462 per cy. Throughput rates are fairly high, with one full scale operation processing 1,500 tons/day.

## **4.5.5 Summary of Alternative Treatment Technology Practicability**

Alternative treatment technologies, unto themselves, do not offer any practicable solution to the management of 2.6 million cy of UDM from New Bedford/Fairhaven Harbor. This is due to several factors, most notably cost. But the costs for some technologies such as solidification and landfarming, even though comparable to the cost of CAD disposal, do not overcome the fact that there needs to be a permanent receiving site for the treated sediment. It is not known at this time, whether treatment of the UDM would be required for disposal at the proposed preferred upland sites; more tests need to be conducted. The rationale for deeming the alternative treatment technologies evaluated in the New Bedford/Fairhaven DMMP DEIR impracticable are shown in Table 4-4.

**Table 4-4:** Reasons why alternative treatment technologies were deemed impracticable

<b>Technology</b>	<b>Rationale</b>
Chelation	Inability to treat PAHs and PCBs, sidestream wastes, high cost
Chemical Reduction/Oxidation	Inability to treat metals and PAHs, sidestream wastes, high cost
Dehalogenation	Inability to treat metals and PAHs, sidestream wastes, high cost
Fungal Remediation	Inability to treat metals, low removal efficiencies, high cost
Incineration	Inability to treat metals, sidestream wastes, high costs, permitting difficulties. Not recommended for PCBs (may produce dioxins)
In-Situ Bioremediation	Inability to treat certain PAHs and most PCBs, sidestream wastes, limited temp. range
Pyrolysis	Inability to treat metals, sidestream wastes, low sediment moisture content required, high cost, permitting difficulties
Slurry Bioreactor	Inability to treat metals, sidestream wastes, dewatering required after treatment, high cost
Soil Washing	Marginally effective for clay and silt sediments, dewatering after treatment required, high cost
Solid-Phase Bioremediation	
Landfarming	Inability to treat metals and PAHs, not suited for cold climates, ineffective on PCBs, sidestream wastes, land intensive, long duration
Composting	Inability to treat metals, space intensive, sidestream wastes, questionable effectiveness PAHs and PCBs, high cost
In-Vessel Bioremediation	Inability to treat metals, sidestream wastes, questionable effectiveness high molecular weight PAHs and highly chlorinated PCBs , high costs
Solidification/Stabilization	Final product volume significantly larger than original dredged material, market demand, high costs. Stabilization of organic compounds is uncertain for PCBs.
Solvent Extraction	Inability to treat metals, sidestream wastes, dewatering after treatment required, low effectiveness for silt and clay sediments, high cost
Thermal Desorption	Inability to treat metals, sidestream wastes, low sediment moisture content required, long processing time for clay and silty sediments, high cost
Vitrification	Sidestream wastes, long processing time, extremely high cost



Dehalogenation, soil washing, slurry bioreactors and solvent extraction are effective forms of treatment that demonstrate feasibility for treatment of New Bedford/Fairhaven Harbor UDM potentially contaminated with PCBs. However these treatment technologies are usually not sufficient to treat other types of contaminants and would most likely require other forms of treatment. In addition, a receiving site, such as an industrial or commercial development that requires large quantities of construction fill, would need to be identified. Also, the treated UDM must be competitively-priced with upland sources of fill material in order for the use of treatment technologies to be a practicable solution for the DMMP. Currently, the supply of upland fill material exceeds the demand for construction fill, and at a much lower price (approximately \$20/cy) than that of even the lowest-priced treatment technology.

### 4.5.5.1 Potential Future Alternatives

Alternative treatment technologies may prove viable for small projects, those that deal with unique and/or specific type(s) of contaminant(s), or as an element of a larger UDM management technique. Alternative treatment technology is a rapidly growing and evolving field and it is very likely that as ongoing and future pilot and demonstration projects occur, the universe of technically viable, cost-competitive, and permissible alternatives will emerge.

For this reason, the DEIR carries forward all alternative treatment technologies as "potential future alternatives", and specifies the various general performance standards which an alternative treatment technologies must meet to be seriously considered as a practicable alternative. This flexible approach will provide a baseline from which proponents of alternative treatment technologies can develop and present specific, detailed proposals, and will allow the State to focus its reviews on potentially practicable proposals. This approach is based on the Boston Harbor EIR/EIS. The DMMP will reevaluate, on a five year cycle, the feasibility of alternative treatment technologies for UDM in New Bedford/Fairhaven Harbor and other harbors throughout the Commonwealth.

CZM is aware that DEP is currently performing two major regulation reassessments that might affect the potential for alternative treatment technologies and/or beneficial use of dredged material. DEP is reassessing the BUD regulations and is expected to issue revised regulations in 2002. BUD revisions will be reviewed to determine whether they will have any significant impact on permissibility. DEP's revision to its 401 WQC Dredging Regulations, to develop a set of comprehensive regulations for dredging and management of dredged material, anticipates going to public review/promulgation in late 2002 and will take into account planning, permitting, and implementation phases. Additionally, CZM is represented on the regulation revision workgroup and has been incorporating drafts of the regulations into the DEIR as guidance.

## 4.6 Dewatering Site Selection

In order to consider upland disposal/reuse as a viable option for the disposal of dredged material, adequate land area is required to accommodate the process to prepare dredged material for final disposal or reuse. A site or series of sites is needed to process and dewater dredged material to reduce the moisture content before transfer to an upland disposal or reuse site. As part of the DMMP DEIR process of exploring potential disposal options, harbor-side and upland site requirements were examined for transferring dredged material from the marine environment to the upland environment for final disposal/reuse.

### 4.6.1 Screening Process

An initial windshield survey of waterfront accessible areas throughout the shorelines of New Bedford and Fairhaven was conducted to produce a list of potential dewatering sites. Dewatering site criteria such as size, topography and accessibility were the main factors considered during the initial windshield survey. The potential dewatering sites produced during the initial windshield survey were examined against specific screening factors so that feasible dewatering site alternatives could be identified. Input from local municipal officials and the New Bedford/Fairhaven Dredged Material Management Committee were also incorporated into the search for dewatering sites.

The DMMP dewatering screening process is a two tier process involving the first tier or initial screening of *exclusionary* site factors and a second tier screening of *discretionary* factors. The exclusionary factors only apply to the harbor-side site requirements, all other criteria are discretionary. The harbor-side requirements are exclusionary because, being the first link in the “dewatering/upland disposal process train”, dewatering is the limiting factor for consideration of upland disposal. Thus, if a harbor-side site meeting the minimum requirements for dewatering could not be located, then upland disposal options are not feasible.

### 4.6.2 Screening Factors

The exclusionary factors for first tier dewatering process screening are described below:

**D-1. Proximity to Dredging Site** - Located within the developed shoreline of New Bedford and Fairhaven. These shorelines extend into Buzzards Bay proper and this was deemed a reasonable hauling distance for a sediment-loaded barge (M. Habel, personal communication). This screening criteria also factors in the compatibility of existing shoreline land uses. Shoreside locations that are residential or recreational were eliminated because of incompatibility with the industrial nature of dredged material stockpiling and its associated impacts.

**D-2. Pier Requirements** - Pier or bulkhead with a minimum length of 120 feet. The harbor-side site adjacent to the pier must be adequately sized to provide an off-loading area and be capable of accommodating two way truck traffic. An area that does not have a pier/bulkhead was considered if construction of a temporary structure would be practicable.

**D-3. Water Depth** - The pier must have a minimum water depth of 12 feet during all tides. If an area is shallower than 12 feet, but has other positive attributes which could make it a suitable dewatering site, then the site may be considered. This would be possible only if minimal dredging is required to obtain the necessary water depth.

**D-4. Dewatering Area** - A minimum area of 3.2 acres is needed to provide for a diked dewatering facility for a 10,000 cy project (Figure 4-5). This includes adequate area to allow the treatment of effluent and/or connection to local sewer system.

Second tier discretionary screening factors include the following:

**D-5. Timing/Availability** - The site (or sites) must be available for the time frame required by the particular dredging project(s) to process dredged material.

**D-6 - Access to Transportation Network** - The site(s) should be located in an area that has adequate land-side access provided by the existing transportation network. Sites requiring minor upgrading, such as re-paving or constructing a temporary access road may be considered, provided the connecting transportation network is adequate to accommodate the trucking needs associated with the transportation of dredged material.

**D-7. Haul Routes** - Selected haul routes should avoid lateral or vertical obstructions or any other restrictions. Evaluation of sensitive receptors passed on the haul route should be considered. Other potential logistical problems/conflicts that might be encountered accessing a site should also be identified.

**D-8. Present Habitat Types** - Sites shall be evaluated for general vegetation cover, presence of wetlands, rare plant/wildlife habitat, and the surrounding landscape.

**D-9. Existing Terrain** (suitability to diking) - Site examination to determine potential for dike construction.

**D-10. Flood Plains** - National Flood Insurance Program, Flood Insurance Rate Maps will be consulted for each site to determine if a site is in or partially in a designated flood plain.

**D-11. Agricultural Use** - Determination of prime agricultural soils on the site.

**D-12. Surrounding Land Use** - Evaluation of adjacent ownership, present and projected land use. Sites located in industrial or commercial areas are preferred over sites in or adjacent to residential or recreational areas.

**D-13. Odors/Dust/Noise Receptors** - Evaluation of potential impacts and distance to sensitive receptors of odors, dust and noise from dewatering process methods selected. Sites at a distance from sensitive receptors are preferred over sites adjacent to sensitive receptors.

**D-14. Consistency with Port Plan** - Each proposed site was reviewed for consistency with the New Bedford/Fairhaven Harbor Plan, specifically to determine whether the site(s) enhance(s) the values articulated in the Plan and conform to projected site-specific uses. This criteria is only applicable to potential dewatering sites identified within the municipal boundaries of New Bedford or Fairhaven.

**D-15. Local, Regional, State Plans** - Evaluation of consistency with Local, Regional and State long-range plans.

**D-16. Ability to Obtain Permits** - Likelihood of local, state, and federal regulatory approval.

**D-17. Cost** - The cost of the construction, operation, and restoration of the site was calculated for comparative purposes.

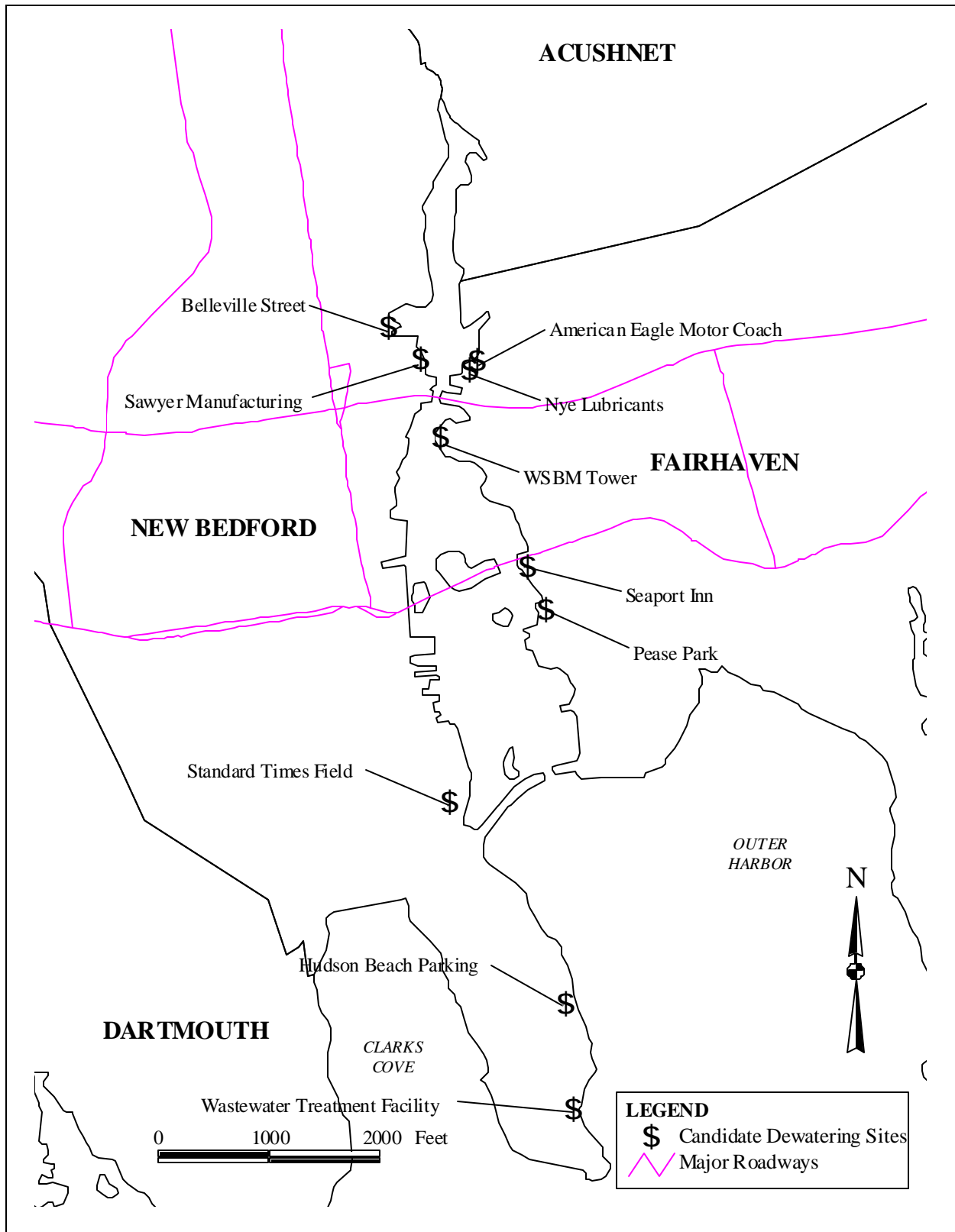
### ***4.6.3 Screening Results***

A total of 10 candidate dewatering sites were identified (Figure 4-10), 5 in New Bedford and 5 in Fairhaven. All sites were subject to a windshield survey and review of existing information. Each dewatering site was evaluated against the evaluation factors listed above, and this information was recorded on data sheets (Figure 4-11) for each site. The dewatering site screening evaluation is summarized below.

#### **4.6.3.1 Exclusionary Screening**

A strict interpretation of the exclusionary screening criteria resulted in all candidate sites failing the screen (Table 4-5). Eight of the ten sites would require pier construction. The remaining two have piers that would need substantial upgrading. Five of the sites were less than 3.2 acres in size, thereby failing the minimum size criteria. Nine of the 10 sites have inadequate water depth and, therefore, would require dredging. Many of these sites are adjacent to sensitive marine resources (e.g. mud flats, salt marsh), therefore dredging to create shore side access would result in negative ecological impacts.

Since all sites failing the exclusionary screening criteria, another site, the Railyard site, was considered as a dewatering site. The Railyard Site is also the site of EPA's CDF "D" and was also considered as a potential CDF site for the New Bedford Harbor DMMP (see Section 4.8). Initially, it was thought that this site could potentially be used for two purposes: dewatering of DMMP sediments, and permanent storage of sediments from the Superfund remediation. After discussions with EPA, it was deemed that the use of the site for dewatering would present significant conflicts with EPA's CDF construction, operation and maintenance, therefore, the site was eliminated from further consideration.



**Figure 4-10:** Candidate Dewatering Sites

<b>DEWATERING SITE SCREENING</b>		
<b>SITE LOCATION 1</b>		
HARBOR:	SITE NAME:	
CITY/TOWN: Lynn	SITE ADDRESS:	
GENERAL DESCRIPTION:		
<b>SITE CHARACTERISTICS</b>		
<b>Proximity to Dredging Site (D-1):</b>		
Miles from Dredging Projects		
<i>Comments:</i>		
<b>Pier Requirements (D-2):</b>		
Length (Feet)	Able to Accommodate Two Way Truck Traffic	
Possible to create Pier:		
<b>Water Depth (D-3):</b>		
Minimum Water Depth (Feet)		
Possible to dredge to 12 feet:		
<b>Dewatering Area (D-4):</b>		
Area (Acres)	Dewatering Method	
<i>Comments:</i>		
<b>Timing / Availability (D-5):</b>		
Availability	Time Frame	Ownership
<b>Access to Transportation (D-6):</b>		
Proximity to Highways (Miles)	Proximity to Rail (Miles)	
<i>Comments:</i>		
<b>Dredged Material Haul Route (D-7):</b>		
Restrictions /Obstructions	Sensitive Receptors	
<i>Comments:</i>		

Figure 4-11: Dewatering Site Data Sheet Sample

<b>Present Habitat Types (D-8):</b>		
<i>Summary Type:</i>		
<b>Successional Stage (D-8.a):</b>		
<b>Disturbance (degree) (D-8.b):</b>		
<b>Plant/Animal Diversity (D-8.c):</b>		
<b>Plant/Animal Integrity (D-8.d):</b>		
<b>Landscape Position (D-8.e):</b>		
<b>Wildlife Function/Use (D-8.f):</b>		
<b>Existing Terrain - suitability for diking (D-9):</b>		
<b>Topographical Characteristics</b>	<b>Comments</b>	
<b>Flood Plains (100 year) (D-10):</b>		
<b>% Coverage</b>	<b>Comments</b>	
<b>Agricultural Use (D-11):</b>		
<b>Description</b>	<b>Comments</b>	
<b>Surrounding Land (D-12):</b>		
<b>Existing Land Use</b>	<b>Projected Land Use</b>	
<b>Comments:</b>		
<b>Odor/Dust/Noise Receptors (D-13):</b>		
<b>Name/Description</b>	<b>Distance</b>	<b>Comments</b>
<b>Consistency with Port Plan (D-14):</b>		
<b>Consistency with Stated Goals</b>	<b>Relationship to Preferred Alternative</b>	
<b>Comments:</b>		
<b>Local, Regional, State Plans (D-15):</b>		
<b>Local</b>	<b>Regional</b>	<b>State</b>
<b>Comments:</b>		
<b>Ability to Obtain Permit (D-16):</b>		
<b>Consistency with Federal Regulations</b>	<b>Consistency with State Regulations</b>	
<b>Comments:</b>		
<b>Cost (D-17):</b>		
<b>Construction</b>	<b>Operation</b>	<b>Restoration</b>
<b>Approx</b>		

Figure 4-11: Dewatering Site Data Sheet Sample (continued)

#### 4.6.3.2 Discretionary Screening

Each potential dewatering site was also evaluated relative to the discretionary screening criteria (Table 4-5). As all the sites have been eliminated based on the exclusionary screening alone, it is reasonable to focus on those sites with the largest available land because land size is one of the most critical attributes of a dewatering site. The Nye Lubricants Site (4) is a 4.9-acre, privately owned commercial/industrial site that is currently used as a parking lot. The site is located above the I-95 bridge in the upper harbor where water-side access is limited by shallow water (less than 6 ft) and the presence of low clearance bridges.

Standard Times Field (8) is a 20.7-acre site owned by the City of New Bedford. The site borders a salt marsh and is primarily open field. The City of New Haven has petitioned that this site not be used for disposal of dredged material.

Also owned by the City of New Bedford is the Wastewater Treatment Facility site. This site 17.2 acres in size and is currently used mostly as a parking lot, however, a park area has been recently constructed on the site. The water is shallow (less than 6 ft) and there is no pier so dredging and pier construction would be required.

The USEPA is currently planning to transport dredged material to upland disposal locations that it will be remediating as part of the Superfund project. As part of this revised alternative, USEPA will be establishing a desanding facility in the Upper Harbor, where desanded material would be pumped, via a pipeline, to an enclosed sediment dewatering facility (to be built) along the western side on the Inner Harbor. Dewatered dredged material would then be loaded onto railway cars and transported to an upland disposal facility. While future potential opportunities to use this site by entities other than USEPA are unknown at the present time, an assessment of practicability for use as part of the DMMP will be included in the FEIR. However, based upon the costs and limited capacity available for upland disposal of DMMP material and logistical concerns (potential cross-contamination), this option is not expected to provide a cost-effective option for most of the UDM.

Based on the analysis described above, there are no practicable dewatering sites available within New Bedford/Fairhaven Harbor for DMMP material. The lack of a dewatering site is a hindrance to any upland disposal or treatment technology as these two methods of disposal /treatment require dewatering as a necessary element in the process.



**Table 4-5:** New Bedford/Fairhaven Harbor potential dewatering site screening summary

Site	Pease Park	Seaport Inn	WSBM Tower	Nye Lubricants	American Eagle Motor Coach	Belleville Street	Sawyer Manufacturing	Standard Times Field	Hudson Beach Parking	Wastewater Treatment Facility
Map ID	1	2	3	4	5	6	7	8	9	10
<b>EXCLUSIONARY CRTIERIA</b>										
Distance	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pier	No	Yes	No	No	No	No	Yes	No	No	No
Depth	<6	6	<6	<6	<6	<6	15	<6	<6	<6
Area	0.9	0.6	1.0	4.9	3.1	10.8	1.8	20.7	2.8	17.2
<b>DISCRETIONARY CRTIERIA</b>										
Availability	Town	Private	Private	Private	Private	City Owned	Private	City Owned	City Owned	City Owned
Access	Good	Excellent	Good	Good	Good	Good	Good	Good	Good	Good
Hual Routes	Commerical /Residential Area	Adjacent to Route 6	Residential Area	Commerical /Industrial Area	Commerical /Industrial Area	Commerical /Residential Area	Commerical /Industrial Area	Commerical /Industrial Area	Commerical /Residential Area	Commerical /Residential Area
Habitat	Urban Park	Parking Lot	Salt Marsh	Parking Lot	Parking Lot	Disturbed	Parking Lot	Salt Marsh /Open Field	Parking Lot	Parking Lot
Terrain	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat
Flood Plains	AE	AE	VE	VE	VE	VE	VE	A0	AE	AE
Agricultural	No	No	No	No	No	No	No	No	No	No
Land Use	Commerical / Residential Area	Adjacent to Route 6	Residential Area	Commerical / Industrial Area	Commerical / Industrial Area	Commerical / Residential Area	Commerical / Industrial Area	Commerical / Industrial Area	Commerical / Residential Area	Commerical / Residential Area
Receptors	Yes	No	Yes	No	Yes	Yes	No	No	Yes	No
Port Plan	No Conflict	No Conflict	No Conflict	No Conflict	No Conflict	No Conflict	No Conflict	Conflict - Marine Industrial	No Conflict	No Conflict
Other Plans	No Conflict	No Conflict	Conflict	No Conflict	No Conflict	Conflict	Conflict	No Conflict	No Conflict	Conflict
Permits	unlikely	likely	unlikely	unlikely	unlikely	unlikely	likely	unlikely	unlikely	unlikely
Cost	\$ 19,800	\$ 13,200	\$ 22,000	\$ 107,800	\$ 68,200	\$ 237,600	\$ 39,600	\$ 455,400	\$ 61,600	\$ 378,400
Comments	Town Boat Ramp, Requires pier construction and dredging, small size	Private Development Plans, small size	Future Site of Marsh Island Recreation Site - Port Plan, Site requires pier construction and dredging	Recently Redeveloped, limited access - bridges	Commercial Use - limited access - bridges, pier construction and dredging required	Adjacent to 195 CDF, Mudflat resources, plans to develop park, pier construction and dredging required	Adjacent to EPA CDF "C", limited access - bridges, small size, pier rehabilitation needed	City Prohibition on use of site as CDF - Mudflats resources, pier construction and dredging required	City Beach Parking, small size, pier construction and dredging required	Park recently developed, pier constnction and dredging required.

	- FAILED EXCLUSIONARY SCREENING
	- FAILED EXCLUSIONARY CRITERIA
	- PASSED EXCLUSIONARY CRITERIA

n/a	- Not evaluated based upon results of exclusionary screening
-----	--

## 4.7 Upland Disposal/Reuse Alternatives

### 4.7.1 Screening Process

The purpose of the upland disposal site screening process is to identify sites where disposal of dredged material would be feasible and be the least environmentally damaging to the natural and human environment. This was accomplished by employing a tiered screening process depicted in Figure 4-7. The screening follows the guidelines of 40 CFR Part 230, established under Section 404(b)(1) of the Clean Water Act (CWA) and complying with 310 CMR 16.00 (Site Suitability Regulations) for dredged materials classified as solid waste by DEP (MDPW, 1990).

The first tier involved the establishment of a Zone of Siting Feasibility (ZSF), which determined the general area that was to be studied for site selection. The ZSF was established based upon a reasonable truck travel distance from New Bedford/Fairhaven Harbor. A 50-mile ZSF (Figure 4-12) was established because it is the maximum distance a truck could travel to and from the dewatering site in a normal 8-hour working day. This included the time for loading and off-loading at the dewatering site and disposal site, respectively. The upland ZSF includes: all of southeastern Massachusetts; all of Rhode Island; and, much of eastern Connecticut.

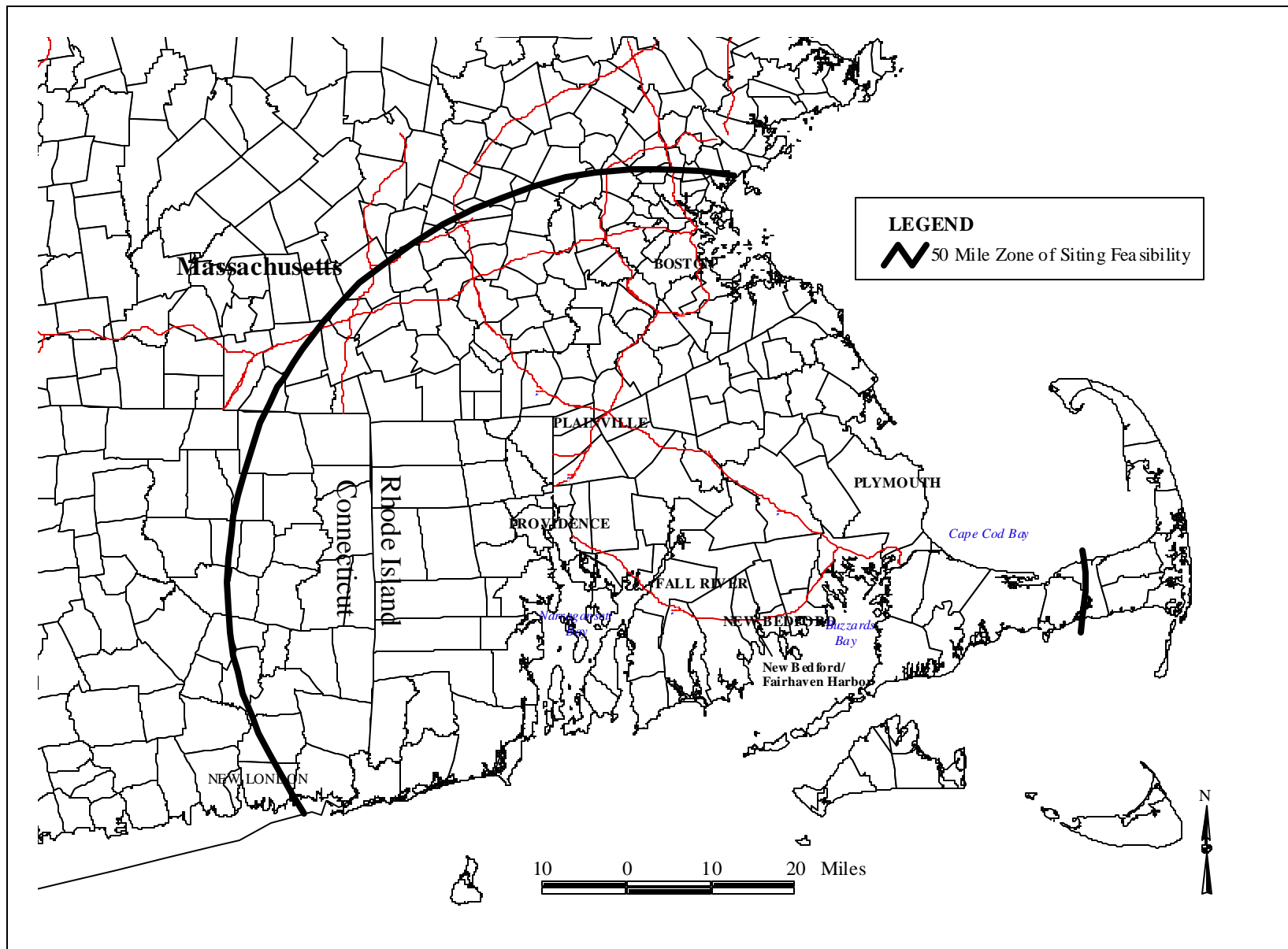
The universe of upland sites was compiled from the following sources, including several previous siting studies that have been conducted for dredged material disposal and disposal/reuse of other materials:

- C Boston Harbor Navigation Improvement Project
- C Central Artery/Tunnel Project
- C MWRA Residuals Management Facility Plan
- C DEP Active Municipal Solid Waste Landfills and Active Demolition Landfills in Massachusetts
- C DEP Inactive or Closed Solid Waste Landfills in Massachusetts
- C Massachusetts Division of Capital Asset Management Inventory of State-Owned Properties
- C Lists of active landfills in Connecticut and Rhode Island
- C Meetings and conversations with local, state and federal agencies
- C Requests for Expressions of Interest in major newspapers
- C Requests for Expressions of Interest mailed to every municipality within the ZSF

This compilation resulted in a universe of 1,123 sites within the ZSF. These sites were then subjected to a feasibility screen, where sites that were smaller than the minimum size required to accommodate a certain volume of dredged material were eliminated.

The criteria for determining the minimum disposal site size was based upon two primary factors:

1) the minimum area required to accommodate 10,000 cy of dredged material; and, 2) setback distances for solid waste management facilities as specified in the Massachusetts DEP Solid Waste Management Regulations at 310 CMR 19.000. The 10,000 cy minimum volume was selected because it is the threshold for triggering environmental review under MEPA and it is a volume that is typical of smaller, marina dredging projects along the North Shore. A 500-foot buffer distance from the potential disposal area to adjacent properties was assumed as per DEP regulations.



**Figure 4-12:** Upland Zone of Siting Feasibility

This resulted in a minimum disposal area of 25 acres. Any of the 1,123 sites less than 25 acres in size were eliminated. There were 270 sites eliminated based upon this criteria, leaving 853 remaining candidate sites.

The candidate sites were screened through a series of exclusionary criteria that examined factors that would essentially prohibit upland disposal based upon state or federal law or regulation. The close proximity to drinking water supplies, is an example of an exclusionary criteria which, would precludes the area from use as a disposal site. After applying the five exclusionary criteria (discussed in Section 4.7.2.1) 837 additional sites were eliminated, leaving 8 potential alternatives within the 50-mile ZSF, which were carried forward for further analysis.

The potential alternatives were then evaluated based upon a set of secondary or discretionary criteria, consisting of 15 factors that could affect the feasibility and potential impacts of a disposal site. These factors are shown in the upland site data sheets (Figure 4-13) and are described in Section 4.7.2.1.

Each of the potential alternative sites (Figure 4-14) were then compared, relative to one another, using the discretionary criteria. Finally, DEP policies and regulations related to waste disposal were applied to the set of potential alternatives to determine the relative feasibility of each site for accepting dredged material.

#### ***4.7.2 Screening Factors***

In conclusion, after sites were eliminated based upon size and capacity in the feasibility screen , the candidate sites were then screened using a set of exclusionary criteria. The potential sites still remaining after these two initial screening processes were then evaluated using a set of discretionary criteria, which included the feasibility of obtaining approvals for these sites based upon existing DEP policies and regulations regarding waste management.

<b>UPLAND DISPOSAL SITE SCREENING</b>		
<b>SITE LOCATION</b>		
HARBOR:	SITE NAME:	
SITE COORDINATES:		
<b>PHYSICAL CHARACTERISTICS</b>		
Disposal Type(s): Potential Capacity (cy x10 <sup>3</sup> ): Present Land Use: Adjacent Land Use (U-15): Physical Area of Impact (acres) (U-9):		
<b>Site Accessibility (U-8):</b>		
Route	Distance	Logistics
		[Including time of transport, road types, rehandling, and storage]
Trucking Limitations:		
<b>Duration of Potential, Adverse Long-term Impacts (U-10):</b>		
Duration	Severity	Comments
<b>Existing Terrain (U-12):</b>		
Topographical Characteristics	Comments	
	[Including suitability for diking]	
<b>DESIGN CHARACTERISTICS</b>		
<b>Ability to Obtain Permit (U-19):</b>		
Consistency with Federal Regulations	Consistency with State Regulations	
<b>Risk of Containment Facility Failure (U-16):</b>		
Geotechnical Stability	Foundation Stability	Comments
<b>Consistency with Local, Regional, and State Plans (U-18):</b>		
Values	Site-specific Uses	

Figure 4-13: Example of Upland Disposal Site Data Sheet

Estimated 20 year Cost (U-20):		
Construction	Maintenance	Monitoring

EXCLUSIONARY USE FACTORS

Critical Habitat for Federal or State, Rare and Endangered Species (U-1):			
Species	Designation (S/F)	Habitat Use	Seasonality
		[Breeding/Resident/ Migratory/Habitat]	

Historic/Archeological Sites or Districts (U-2):	
Type of Site	Significance of Features

Drinking Water Supply – Groundwater (U-3):	
Zone II	Sole Source Aquifer

Drinking Water Supply – Surfacewater (U-4):	
More than 0.5 Miles Upgradient nearest source	Comments

National Seashore (U-5.a):		
Name	Distance	Comments

Wilderness Area (U-5.b):			
Name	Distance	Type	Comments

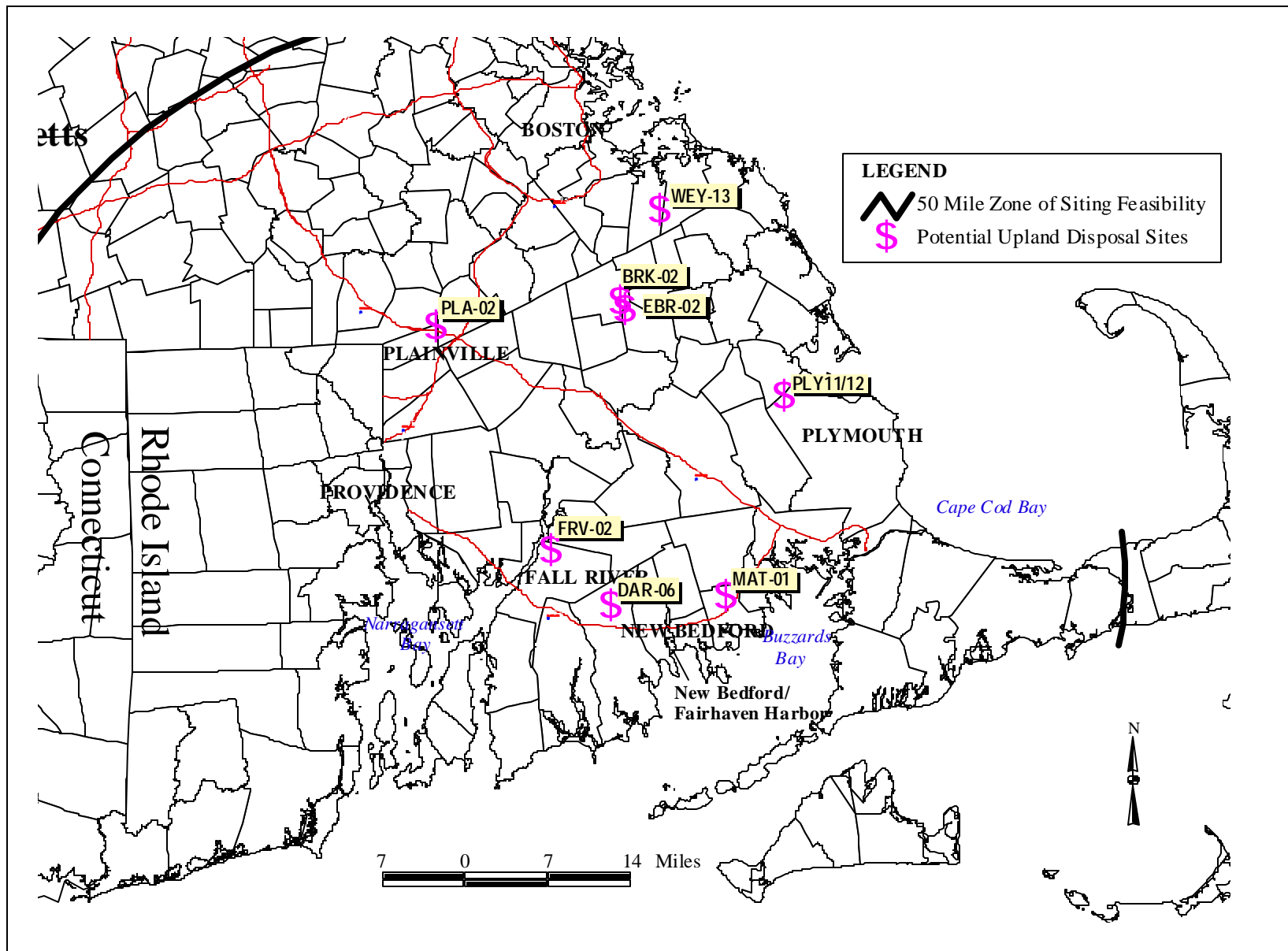
  

ACEC's (Areas of Critical Concern) (U-5.c):			
Name	Distance	Type	Comments

Figure 4-13: Example of Upland Disposal Site Data Sheet (continued)

<b>DISCRETIONARY USE FACTORS</b>		
<b>Groundwater – General (U-6):</b>		
Depth to Groundwater	Comments	
<b>Surface Water - Rivers (U-7.a):</b>		
Name	Distance	Potential for Water Quality Degradation
<b>Surface Water - Wetlands (U-7.b):</b>		
Name	Distance	Potential for Water Quality Degradation
<b>Flood Plains (U-13):</b>		
Percent Coverage, 100 year	Comments	
<b>Agricultural Use (U-14):</b>		
Description	Comments	
<b>Odor/Dust/Noise Receptors (U-17):</b>		
Name/Description	Distance	Comments
<b>BIOLOGICAL USE FACTORS</b>		
<b>Present Habitat Types (U-11):</b>		
<i>Summary Type:</i>		
<i>Recovery Potential:</i>		
<b>Successional Stage (U-11.a):</b>		
<b>Disturbance (degree) (U-11.b):</b>		
<b>Plant/Animal Diversity (U-11.c):</b>		
<b>Plant/Animal Integrity (U-11.d):</b>		
<b>Landscape Position (U-11.e):</b>		
<b>Wildlife Function/Use (U-11.f):</b>		

Figure 4-13: Example of Upland Disposal Site Data Sheet (continued)



**Figure 4-14:** Potential Upland Disposal Sites



### 4.7.2.1 Exclusionary Factors

The following exclusionary factors were applied to those sites 25 acres in size or greater, i.e. the candidate disposal sites:

**U-1. Threatened and Endangered Species** - (Critical habitat or resource-use area for federal or state listed threatened or endangered species or species of special concern) - The locations of the sites identified in the initial screening were identified in the Massachusetts Natural Heritage Atlas which utilizes information from the USFWS to map and list these state and federal species.

**U-2. Historic/Archeological Sites or Districts** - The sites were evaluated for potential cultural resource constraints through consultation with the Massachusetts Historical Commission and review of any local, State or National designations for the site.

**U-3. Drinking Water Supply - Groundwater** - Sites were evaluated for proximity to an area with groundwater with Zone II designation and Sole Source Aquifer (SSA) designation. The Massachusetts Department of Environmental Protection created three zones to identify Wellhead Protection Areas which are designed to outline potable public groundwater sources. Sites with a Zone II designation can be defined as, the entire extent of the aquifer deposits which could fall within, and upgradient from, the production well's capture zone based on the predicted drawdown after 180-day drought conditions at the approved pumping rate (Massachusetts Department of Environmental Protection, 2000). A SSA is an aquifer designated by the United States EPA as the 'sole or principal source' of drinking water for a given aquifer service area and which is needed to supply 50% or more of the drinking water from that area and for which there are no reasonably available alternative sources if that aquifer became contaminated (United States Environmental Protection Agency, 2000).

**U-4. Drinking Water Supply - Surface Water** - Sites were evaluated for proximity to public drinking water supplies, location within one-half mile upgradient of a surface water supply, potential pollutant pathways to a water supply, and potential for water quality degradation.

### **U-5. Land Designation**

**U.5.a - National Seashore** - Sites were evaluated for federal designation as a National Seashore. Massachusetts Solid Waste Regulations, 310 CMR 19.000, prohibit placement of unsuitable material in a designated National Seashore area.

**U.5.b - Wilderness Area** - Sites were evaluated for federal designation as a Wilderness Area. Massachusetts Solid Waste Regulations, 310 CMR 19.000, prohibit placement of unsuitable material in a designated Wilderness Area.

**U.5.c - Area of Critical Environmental Concern (ACEC)** - Sites were evaluated for state designation as an Area of Critical Environmental Concern (ACEC). ACECs are areas containing concentrations of highly significant environmental resources that has been formally designated by the Commonwealth's Secretary of Environmental Affairs for preservation and enhancement of the land's natural assets (Massachusetts Department of Environmental Management, 2000). Massachusetts Solid Waste Regulations, 310 CMR 19.000, prohibit placement of unsuitable material in an ACEC.

#### 4.7.2.2 Discretionary Factors

The following discretionary factors were used to evaluate the 11 potential upland disposal sites that survived the exclusionary criteria screening process.

**U-6. Groundwater - General** - Evaluation of the types of aquifers in the vicinity and depth to groundwater at the site.

#### **U-7. Surface Water Quality**

**U.7.a - Water Bodies and Rivers** - Evaluation of the sites' setback (distance of the site from the shoreline) from waterbodies and rivers.

**U.7.b - Wetlands** - Evaluation of setback of sites from wetland resource areas.

**U-8. Site Accessibility** - Description of the most practical route to transport dredged material to the disposal site, including any potential logistical problems that might be encountered during use or construction of the proposed site. Sites should be directly accessible from a regional highway, have a rail or navigable waterway nearby, have a local access route that does not include lateral or vertical obstructions or restrictions, and have a local access route that does not pass by sensitive receptors.

**U-9. Physical Area of Impact** - Evaluation of the amount of land area in acres that would be directly affected by disposal activities.

**U-10. Duration of Potential, Adverse Impacts** - Estimation of recovery time based on the type of disposal and present site conditions.

#### **U-11. Present Habitat Types**

**U-11.a - Successional Stage** - Evaluation of vegetation stage (e.g., forest, grass) and whether wetlands were present.

**U-11.b - Degree of Disturbance** - Evaluation of the visual evidence of site disturbance, including physical disruptions such as land clearing or development; and ephemeral disturbances such as noise or temporary land usage.

**U-11.c - Diversity of Plant and Animal Species** - Evaluation of the type and amount of vegetative cover to estimate species diversity, highlighting the presence of wetlands on or adjacent to the site, and considering influence of topography and soil types.

**U-11.d - Integrity of Plant and Animal Communities** - An evaluation of the plant and animal community integrity by considering the degree of disturbance that the site and the surrounding landscape conditions, and their potential impact on the habitat and species of native flora and fauna at the site.

**U-11.f - Wildlife Function** - Assessment of wildlife value by considering degree of disturbance and landscape position as well as the presence of breeding, feeding, resting/roosting areas, presence or connectivity to dispersal areas, presence of food and cover, and other wildlife attributes.

**U-12. Existing Terrain (suitability for diking)** - Determination of ability to construct a dike around disposed sediment in light of existing terrain.

**U-13. Flood Plains** - Determination whether site is within or partially within a designated floodplain, consulting National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRMs).

**U-14. Agricultural Use** - Determination of prime agricultural soils on or near the site.

**U-15. Adjacent Land Use** - Evaluation of adjacent ownership, present and projected land use.

**U-16. Risk of Containment Facility Failure** - Review of characteristics and engineering requirements for each site to assess the potential stability of material disposed of at the site.

**U-17. Odors / Dust / Noise** - Evaluation based on proximity of odors, dust and noise generated on-site to sensitive receptors such as residential areas, schools, cemeteries, etc.

**U-18. Local, Regional, State Plans** - Evaluation of consistency with local, regional and state long range plans.

**U-19. Ability to Obtain Permits** - Evaluation of likelihood of local, state, and federal regulatory approval.

**U-20. Cost** - Estimation of comparative costs for construction, maintenance, and monitoring of proposed sites.

**Table 4-6:** Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Upland Disposal/Reuse

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
<b>PRE-SCREENING</b>		
<i>Geographic Area</i>	50-mile radius; Beyond MA state boundaries, only commercial opportunities were considered	Maximize proximity to dredging activity
<i>Capacity</i>	>10,000 c.y	Maximize capacity
<b>INITIAL SCREENING (E)</b>		
<i>U-1. Rare and Endangered Species</i> 310 CMR 19.00	Rare or endangered species habitat	Avoid rare or endangered species habitat
<i>U-2. Historical/Archaeological Sites</i> 310 CMR 19.00	Presence of Local, State, or National Historic Site	Avoid Local, State, or National Historic Sites
<i>U-3. Drinking Water Supply - Groundwater</i> 310 CMR 19.00	Proximity to Zone II and Sole Source Aquifer	Avoidance of Zone II and Sole Source Aquifer
<i>U-4. Drinking Water Supply - Surface Water</i> 310 CMR 19.00	Setback greater than ½ mile up gradient of water supply	Beyond ½ mile upgradient
<i>U-5. Land Designation</i> <i>U-5.a - National Seashore</i> E - 310 CMR 19.00 <i>U-5.b - Wilderness Area</i> E - 310 CMR 19.00 <i>U-5.c - Area of Critical Environmental Concern(ACEC)</i> E - 310 CMR 19.00	National Sea Shore Designation (Federal)  Wilderness Area Designation (Federal)  ACEC Designation (State)	Avoid designated sites.  Avoid designated sites.  Avoid designated sites.
<b>SECOND TIER SCREENING (D)</b>		
<i>U-6. Groundwater - General</i> <b>D</b>	Depth to groundwater	Maximize separation distance
<i>U-7. Surface Water</i>  <i>U-7.a - Water Bodies and Rivers</i> <b>D</b>  <i>U-7.b - Wetlands</i> <b>D</b>	Setback from river, water quality degradation  Setback from wetland, water quality degradation	Protect river quality  Protect wetland quality
<i>U-8. Site Accessibility</i> <b>D</b>	Trucking limitations, length, time to transport, road types, re-handling, storage	Minimize disruptions Maximize efficiency Reduce risks of re-handling
<i>U-9. Physical Area of Impact</i> <b>D</b>	Size of area affected	Minimize area adversely affected
<i>U-10. Potential Adverse Long-term Impacts</i> <b>D</b>	Time, severity, recovery period	Minimize impacts

## SECTION 4.0 - ALTERNATIVES ANALYSIS

**Table 4-6:** Summary of Exclusionary (E) and Discretionary Screening Factors for Upland Disposal/Reuse (continued)

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
<b>U-11. Present Habitat Types</b>		
<b>D U-11.a - Successional Stage</b>	Existing conditions	Long-term protection of advanced stage or climax communities and utility over pioneers
<b>D U-11.b - Disturbance (degree)</b>	Existing conditions	Long-term protection of undisturbed sites or sites with least disturbance
<b>D U-11.c - Plant/Animal Diversity</b>	Existing conditions	Long-term protection of sites with greatest diversity.
<b>D U-11.d - Plant/Animal Integrity</b>	Existing conditions	Long-term protection of sites with stable populations of native, non-invasive and diverse flora and fauna
<b>D U-11.e - Landscape Position</b>	Existing conditions	Assure long-term compatibility with adjacent environment types and land use
<b>D U-11.f - Wildlife Function /Use</b>	Existing conditions	Long-term protection of sites which support the greatest number of critical life functions
<b>U-12. Existing Terrain</b> <b>D</b>	Existing terrain suitable for diking	Maximize long-term secure containment
<b>U-13. Flood Plains</b> <b>D</b>	Avoid impacting flood plain	Retain flood storage capacity
<b>U-14. Agricultural Use</b> <b>D</b>	Existence of prime agricultural soils/ agricultural use	Avoid impacting resources
<b>U-15. Adjacent Land Use</b>	Ownership, present and projected use	Maximize long-term retention of greenspace/retain long-term availability
<b>U-16. Facility Failure</b> <b>D</b>	Geotechnical stability, foundation stability	Maximize stability/containment of material
<b>U-17. Odors / Dust / Noise</b> <b>D</b>	Proximity to receptors of odors, dust and noise.	Maximize distance to receptors
<b>U-18. Local, Regional, State Plans</b> <b>D</b>	Consistency with applicable plans	Avoid conflict with long range plans
<b>U-19. Ability to Obtain Permit</b> <b>D</b>	Likelihood of obtaining local, state, and federal approvals	High probability of obtaining necessary approvals
<b>U-20. Cost</b> <b>D</b>	Estimated 20-year cost of construction, maintenance, monitoring	Minimize long-term costs.

### ***4.7.3 Screening Results***

Using the methodology and criteria described above, the initial screening narrowed the universe of sites. This initial screening of the Massachusetts sites was conducted using the following reference sources:

- C Massachusetts Geological Information Systems (MassGIS),
- C United States Geologic Survey Topographic Maps,
- C Massachusetts National Heritage Atlas,
- C Massachusetts Historic Commission maps,
- C Bureau of Waste Site Cleanup Sites Transition and Reportable Releases Lists,
- C Information gathered in previous reports and databases, and
- C Information obtained about sites within the municipal limits of the harbors at meetings with town officials.

Over 1,000 sites within Massachusetts had exclusionary constraints, causing them to be eliminated. Table 4-7 summarizes the results of the initial screening.

The remaining 8 sites either did not have exclusionary constraints or were active commercial landfills or contaminated sediment treatment facilities and therefore could potentially be used as a disposal site for dredged material.

Because the 50-mile ZSF extended into Rhode Island and portions of Connecticut, active commercial landfills within these states were considered. Four commercial landfills were identified, two in each state. However, all are either prohibited from accepting out-of-state material or are not willing to accept dredged material due primarily to capacity constraints.

## SECTION 4.0 - ALTERNATIVES ANALYSIS

**Table 4-7: DMMP Upland Disposal Site Exclusionary Screening Summary**

<b>Site Sources:</b>	<b>Active Landfills</b>	<b>BHNIP</b>	<b>CA/T</b>	<b>DCAM</b>	<b>Planning Depts.</b>	<b>Inactive Landfills</b>	<b>RMFP</b>	<b>UR Parcel s</b>	<b>Total Sites</b>
<b><i>Candidate Sites</i></b>	37	12	6	380	3	368	312	5	1,123
<b><i>Sites Failing Exclusionary Criteria:</i></b>									
Capacity/Status	25	4	0	11	0	162 (2)	67	1	270 (2)
Rare and Endangered Species	0	0	0	37	0 (1)	23	21	0	81 (1)
Zone II Aquifer	1	2	1	19	0	30	71	0	124
Sole Source Aquifer	2	0	1	4	0	17	15	0	39
Surface Water Source	0	0	0	2	0	9	5	0	16
National/Historical Monument	2 (1)	0	0	11	1	62 (1)	68	0	144 (2)
National Seashore	0	0	0	0	0	0	0	0	0
Wilderness Area	1	1 (1)	1	280	1 (1)	37 (1)	59	2	382 (3)
ACEC	0	2	0	31	0	15	14	2	64
21E Site	3 (1)	2	3	4	0 (1)	16 (1)	13	0	41 (3)
Screened by Agency Action	2	1	1	0	0	56	16	0	76
<b><i>Sites Eliminated</i></b>	35 (1)	10 (1)	6	378	2 (1)	362 (4)	309	5	1107 (7)
<b><i>Potential Alternatives:</i></b>									
in Massachusetts <sup>4</sup>	2	2	0	2	1	6	3	0	16
outside New Bedford ZSF									-8
within New Bedford ZSF									<b>8</b>

**Notes:**

1. Sites in parentheses failed the exclusionary screening, but were not eliminated because of their potential as disposal sites.
2. Some sites failed more than one criteria.
3. A site would fail due to capacity/status if: site is smaller than 25 acres, site has capacity less than 10,000 cu yd, site is too narrow to accommodate landfill construction, site has been developed (e.g. residences, industrial park, highway), landfill is closed and capped, landfill only accepts MSW, or site is no longer part of database that included it in this list.
4. Within the overlapping ZSFs of MA North Shore and South Shore Harbors.

**Site Sources:**

Active Landfills - Active MSW Landfills and Active Demolition Landfills in Massachusetts (DEP, April 1998), Connecticut Active Landfill Sites (CT DEP, February 1998), Rhode Island Licensed Solid Waste Landfills (RI DEM March 1996). Landfills Operating - 1997 (NH DES, November, 1997), and Maine: Operating Landfills (Maine DEP).

BHNIP - Boston Harbor, Massachusetts: Navigation Improvement Project and Berth Dredging Project (April 1994).

CA/T - Central Artery/Tunnel Project: Results of Upland Disposal Site Screening Study (November 1990).

DCAM - Massachusetts Division of Capital Assets Management (formerly Division of Capital Planning Operations) Sites.

Planning Depts. - Suggested during meetings with members of Salem Planning Office (December 8, 1998) and Gloucester Planning Office (December 15, 1998).

Inactive Landfills - Inactive or Closed Solid Waste Landfills in Massachusetts (DEP, April 1998).

RMFP - MWRA Residual Management Facilities Plan (MWRA, 1986 and Black and Veatch, 1987).

UR Parcels - Massachusetts Highway Department Uneconomic Remainder Parcels.

#### 4.7.4 Potential Alternatives

The 8 potential upland sites in Table 4-7 have been identified based on the initial screening. Detailed information about each of these sites can be found on data sheets in Appendix C, however a summary of the general characteristics of each site is presented in Table 4-8, followed by a discussion of each site relative to the discretionary criteria.

**Table 4-8:** Potential Upland Disposal Site Characteristics

Site ID	Site Name	City	Present Site Usage	Distance from NB (mi)	Capacity (cy)	Cost (\$/cy)
FRV-02	BFI Fall River Landfill	Fall River	active landfill	11	160,000	\$ 62
EBR-02	Northern Disposal BFI Landfill	E. Bridgewater	inactive landfill	30	711,100	\$137
WEY-13	Bates Quarry	Weymouth	active quarry	37	189,600	\$169
DAR-06	Cecil Smith Landfill	Dartmouth	inactive landfill	5	102,700	\$200
MAT-01	Mattapoissett Landfill	Mattapoissett	inactive landfill	8	38,500	\$214
PLA-02	Plainville Landfill	Plainville	inactive lined	24	172,800	\$217
PLY-11/12	MHD ROW Parcel	Plymouth	undeveloped	25	124,400	\$238
BRK-02	Brockton Landfill	Brockton	unlined inactive	30	42,500	\$333

##### 4.7.4.1 Detailed Screening of Potential Upland Disposal Sites

Map analyses, file reviews, and site visits were used to acquire more detailed information for each potential upland disposal site identified during the initial screening. Detailed information about each of these sites was recorded on the data sheets (see example, Figure 4-13 and Appendix C). DMMP team members and representatives of local, state, and federal governments met and reviewed this information to review potential alternatives. Discretionary factors were discussed to determine the benefits and constraints of using each site.

The sites that survived the detailed screening are “Proposed Preferred Alternatives”. The discretionary evaluation criteria used during the second tier upland disposal site screening are outlined below, with more detailed discussion in section 4.7.2.



### *Existing Site Uses*

Of the 8 potential sites, only one, FRV-02, is an active landfill. The landfill has recently received a permit to expand the facility to create an area capable of accepting about 882,000 cy of material. However, this capacity will be used for municipal solid waste from Fall River and surrounding towns. Approximately 160,000 cy of cover material is need as interim and final cap.

Four of the potential sites are inactive lined landfills. One site, Bates Quarry (WEY-13) is a 106-acre quarry located near Route 3 in Weymouth.. The remained site, PLY-11/12, is an 83-acre undeveloped, wooded parcel owned by the Commonwealth of Massachusetts as highway (Rt. 80) right-of-way.)

### *Groundwater*

To avoid potential impacts to groundwater, sites located atop important groundwater resources were eliminated. Sites located within the Zone II (Zone of Contribution) of a public water supply well, within an Interim Wellhead Protection Area (IWPA), or within a Sole Source Aquifer failed the initial screening, in accordance with the Massachusetts Site Assignment Regulations for Solid Waste Facilities (310 CMR 16.00). None of the potential disposal sites are located above a Zone II, IWPA, or Sole Source Aquifer. The locations of potentially productive and other aquifers at or near the site were considered in the discretionary screening.

To further minimize the potential for the disposal of dredged materials to impact groundwater, the Site Assignment Regulations require that the disposal area be at least four feet above groundwater. At a site that has a shallower groundwater table, the disposal facility can be engineered so that there is at least 4 feet between the lower-most liner and the high level of groundwater.

As indicated above, any disposal facility used or built would be lined to keep any leachate from the dredged material from coming into contact with groundwater. Groundwater sampling via monitoring wells and laboratory analysis of the groundwater samples would be conducted to confirm that leaks into groundwater have not occurred.

Sites FRV-02, EBR-02 and PLA-12 are all lined landfills, therefore, groundwater protection measures are in place. The remaining five sites are either unlined landfills or undeveloped land that would need to be lined for acceptance of UDM. Shallow depth to groundwater (< 3ft.) has been mapped by MASSGIS at EBR-02, FRV-02 and BRK-02. The remaining sites either have deep depth to bedrock or no mapping information is available.

### *Surface Water and Wetlands*

While disposal of dredged material into freshwater wetlands is not absolutely prohibited, it would be difficult to obtain a permit for such an activity. For this reason, candidate upland disposal sites that are wholly or in large part covered with wetlands were eliminated from further consideration. However, sites that contain a minimal amount of wetlands were not, because disposal site design could avoid impacts to the wetlands. However, sites that do not contain any nearby wetlands would obviously be preferred over sites that are adjacent to wetlands.

Wetlands were identified through the use of USGS. Topographic Maps and the National Wetlands Inventory (NWI) mapping developed by the USFWS. The NWI maps only identify and described relatively large wetlands (>5 acres), so other, smaller wetlands and vernal pools may be present at these sites. A site-specific field delineation would be required to define the regulatory limits of these wetlands.

All the potential disposal sites either contain or abut wetlands or waterbodies. The entire western perimeter of the BFI Landfill in East Bridgewater (EBR-02) is a shrub/scrub and forested wetland. The southwest quadrant of the Brockton Landfill (BRK-02) contains a forested shrub/scrub wetland. The Colbrook riverine system runs through DAR-06. Large swamps surround MAT-01 and PLY-11/12 contains many small pockets of open water/wetland and, potentially, vernal pools.

#### *Site Accessibility*

Most of the potential upland disposal sites are existing active or inactive landfills or quarries and, therefore, access to the sites have been improved over the years to accept trucks carrying solid waste or raw materials. Therefore, access is considered good for excellent for all potential sites except PLY-11/12. Because it is an undeveloped parcel, an access road or road system would need to be constructed. However, general access to the site is good because it is located directly off Rt. 80 in Plymouth.

In terms of distance from New Bedford/Fairhaven Harbor, DAR-06 and MAT-01 are closest (<10 miles away). The Fall River Landfill is only 11 miles away and is easily accessible via Interstate 495 and Rt. 24/79. The remaining sites are about 25-37 miles away.

#### *Physical Area of Impact*

The footprint of UDM disposal at the potential disposal sites was estimated based on the existing topography of the land and engineering criteria established in the Commonwealth's Solid Waste Management Regulations. Those sites that can receive dredged material over a smaller area are generally preferred over sites that need large areas to accommodate the same volume of material. Sites that contain natural or man-made depressions can accommodate material over a smaller area compare to level or mounded land. Therefore, the Bates Quarry (WEY-13) and PLY-11/12, which contain topographical depressions, are best suited for limiting physical impact area. Sites such as the Plainville Landfill (PLA-02), a landfill mound, and MAT-01, a drumlin, would require a larger area to accommodate the same volume of material.

#### *Duration of Potential, Adverse Impacts*

Long term adverse impacts would be greatest at sites that have undergone the least disturbance. All sites have some degree of disturbance, even the MHD right-of-way parcel (PLY-11/12) which contains several man-made depressions. The duration of potential adverse impacts will depend on the manner in which the site were to be engineered and proximity to sensitive resources (wetlands, waterbodies, archaeological sites). Such information would be obtained during the preliminary design phase, therefore, it would be difficult to assess the duration of impacts until this level of information is available.

### *Present Habitat Types*

Sites within or near productive, diverse, and undisturbed habitats are least preferred over sites with habitats that have been disturbed. Sites within existing or inactive landfills or quarries have undergone habitat disturbance already and, therefore, are preferred over sites such as PLY-11/12, which are less disturbed and undeveloped parcels of land.

The inactive and active landfills and quarries contain disturbed land, however, several of the potential sites border sensitive ecological areas. Sites EBR-02, DAR-06, BRK-02, and MAT-01 contain, or are surrounded by, sizable wetland areas. Sites DAR-06 and MAT-01 are located near rare, threatened or endangered species habitat. While none of the sites are known to contain such habitat, site specific studies may need to be conducted for confirmation. In any event, the indirect effects of dredged material disposal at these sites would need to be evaluated.

### *Existing Terrain (suitability for diking)*

A disposal site for UDM can be engineered for practically any site conditions. However sites that are level or sites with existing topography that could easily contain dredged material (e.g. quarries, borrow pits) are preferred. As such, the quarry sites, WEY-12 (Bates Quarry) and PLY-11/12, would be most effective in containing the dredged material because of the minimal need for dike/embankment creation. The existing landfills contain moderate to steep slopes, so additional side slope stabilization would need to be engineered.

### *Flood Plains*

Sites that are located outside of the 100-year or 500-year floodplain are preferred over sites that are. Only three of the eight sites have significant floodplain constraints. BRK-02 is 60% covered by the Beaver Brook floodplain. EBR-02 and DAR-06 are 20% covered by floodplain. The rest of the sites either contain a small fraction (2% or less) or no floodplains.

### *Agricultural Use*

None of the sites are currently used for significant agricultural purposes according to MASSGIS data. Sites that are landfills would likely not be used for agricultural purposes in the future because of potential contamination from the landfills. However, a small portion of the Cecil Smith Landfill (DAR-06) is cropland and cropland abuts to the north. Also, about 3% of the Brockton Landfill site (BRK-02) is cropland. Cropland exists about 200 ft west of the Mattapoissett Landfill (MAT-01).

### *Adjacent Land Use*

Sites in industrial or commercial areas are preferred over those in residential, agricultural, or recreational areas. Of the eight sites, the Fall River Landfill (FRV-02) and Bates Quarry (WEY-13) have industrial and/or commercial land uses abutting their properties. FRV-02 abuts an airport and WEY-13 abuts a commercial/industrial area. However, residential areas are also nearby these two sites and FRV-02 abuts a state forest. The remaining six sites abut a mixture of land uses, primarily residential and open space.

### *Facility Foundation Conditions*

Sites containing steep slopes and underlying swamp deposits have less desirable geotechnical stability and, therefore would require a greater degree of engineering in order to create a stable dredged material disposal deposit. Sites EBR-02 and BRK-02 contain 15% swamp deposits over their sites. Due to steep slopes associated with borrow pits at WEY-13 and PLY-11/12, the stability of placing dredged material on these slopes could be problematic. However, further site-specific investigation would be needed to determine facility foundation conditions and engineering measure would need to be employed to meet the minimum criteria set by MDEP.

### *Odors / Dust / Noise*

Disposal sites that are close to residential, recreational, and tourist areas could negatively affect these areas by the odor, dust and noise created from a UDM disposal operation. All sites, except PLY-11/12, have been or are used for industrial-type activities such as landfilling or quarrying. Sensitive land uses in these areas have been previously exposed to odor/dust/noises associated with trucking and disposal of waste materials. In most cases, efforts have been made to minimize these impacts and if these sites were delegated for dredged material disposal, then similar measures would be employed. Site BRK-02 abuts a residential area and a cemetery, both of which could be impacted by odors, dust or noise. A campground and residents are located near the Plainville Landfill (PLA-02). Residential and conservation adjoin EBR-02. FRV-02 is located near a school.

### *Local, Regional, State Plans*

Sites that, according to local, regional and state plans, are planned for continued use as disposal areas are preferred over sites that are not planned for use as disposal areas. Therefore, sites that are active landfills or quarries would be preferred over inactive sites or undeveloped land. Site PLY-11/12, which is currently undeveloped is not targeted for large-scale industrial activities, therefore its use as a disposal site would likely not be consistent with local, regional or state plans.

### *Ability to Obtain Permits*

Because active landfills are currently operating with permits to dispose of certain materials (solid waste, ash), these sites would likely be the easiest for which to obtain the necessary state and local approvals (permits). It would be more difficult to obtain permits for inactive sites because these sites were likely closed for environmental reasons under RCRA. Undeveloped sites such as PLY-11/12 would likely be the most difficult to permit because of the stringent state and local regulations and policies for landfill siting.

The ability to obtain a permit for a quarry site (WEY-13) is unknown, because the use of abandoned quarries for disposal of UDM has not occurred in Massachusetts. One of the key permitting issues is groundwater contamination because the UDM would be placed below the groundwater table, thereby potentially introducing contaminants to the groundwater. The presence of water in the existing quarry would also pose further permitting issues.

### *Cost*

Placing dredged sediments in the upland environment is a relatively expensive disposal option, with unit costs for the potential alternatives ranging from \$67 to \$333 per cubic yard (Table 4-5) . The least expensive is FRV-02 (\$62/cy) and the most expensive is BRK-02 (\$333/cy). The construction of a new facility is generally more expensive than using an active landfill, due to the extra costs required to site, permit, build, monitor, and close the landfill (see Appendix D for itemized costs). Economies of scale also make building a facility at a small site, with minimal capacity, cost more on a unit cost level than a larger facility. This is in part because the same siting and permitting process is required for all sites.

### *Historic and Archaeological Resources*

Data from MASSGIS was reviewed to determine the presence/absence of known historic or archaeological sites within or near the potential upland disposal sites. The specific nature of the historic/archaeological sites was not investigated during this phase of the study. Sites that contain resources of historic or archaeological significance are least preferred, however the mere presence of artifacts may not render a site unpermissible. Sites on the National Register of Historic Places were eliminated during the exclusionary screening phase.

Several sites contain recorded historic and/or archaeological sites and many are in close proximity to such sites. Site FRV-02 contains an archaeological site within and abutting the site. There are two archaeological sites within 250 ft of EBR-02 and two historic sites within 0.25 miles. The Bates Quarry (WEY-13) is located within one-half mile of 18 historic sites, mostly on Pleasant St. to the west. Rabbit Hill Pond is an archaeological site which abuts PLA-02. There are two archaeological sites within 0.4 miles of PLY-11/12, one of which is the Parting Ways Cemetery. The Cecil Smith Landfill site contains an historic woodland settlement at Colebrook Swamp. In addition, an historic cemetery, Evergreen Cemetery, is within 0.35 miles of the site. An archaeological site is about 0.3 miles northwest of the Mattapoisett Landfill.

#### ***4.7.5 The Preferred Upland Disposal Sites***

Upland disposal sites with respect to the discretionary criteria have been evaluated. As a result of the upland disposal site analysis, it has been determined that none of the 8 potential upland disposal sites would be considered preferred alternatives for disposal of UDM from New Bedford/Fairhaven Harbor. Although some of the 8 sites have greater merit than others, none of the sites, either alone or in combination, satisfy the goals of the DMMP. Additionally, all of the property owners were contacted and none expressed an interest in accommodating the DMMP UDM material. There are several environmental, logistical, and cost constraints that make upland disposal an infeasible alternative. Among them are:

1. There is no dewatering site available for the temporary stockpiling and dewatering of UDM. A dewatering site is a mandatory element of the upland disposal process.
2. The lowest cost for upland disposal is \$62/cy. This is more costly than traditional open water disposal or CAD disposal. In addition, the \$62/cy cost would be for disposal of only about 6% of the entire UDM volume.
3. Massachusetts DEP regulations and policies for handling of dredged material, and landfill siting, engineering, and operations are very restrictive. The likelihood for obtaining a permit to site a new landfill is low and even if a site were to become permitted, it would take 5-7 years to achieve all the necessary approvals. While a large-scale facility sited on that schedule could potentially accommodate the outyear dredging projects, the 5-7 year permitting schedule does not accommodate the 0-5 year dredging need.

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## 4.8 Aquatic Disposal Alternatives

Section 4.8 outlines the application of the DMMP disposal site screening process (Figure 4-7) and aquatic screening criteria to the universe of aquatic disposal alternatives. This section presents the evaluation of potential impacts and benefits associated with the identified aquatic sites and details the potential impacts on specific resources in the vicinity of the disposal sites.

### 4.8.1 Aquatic Disposal Site Screening Process

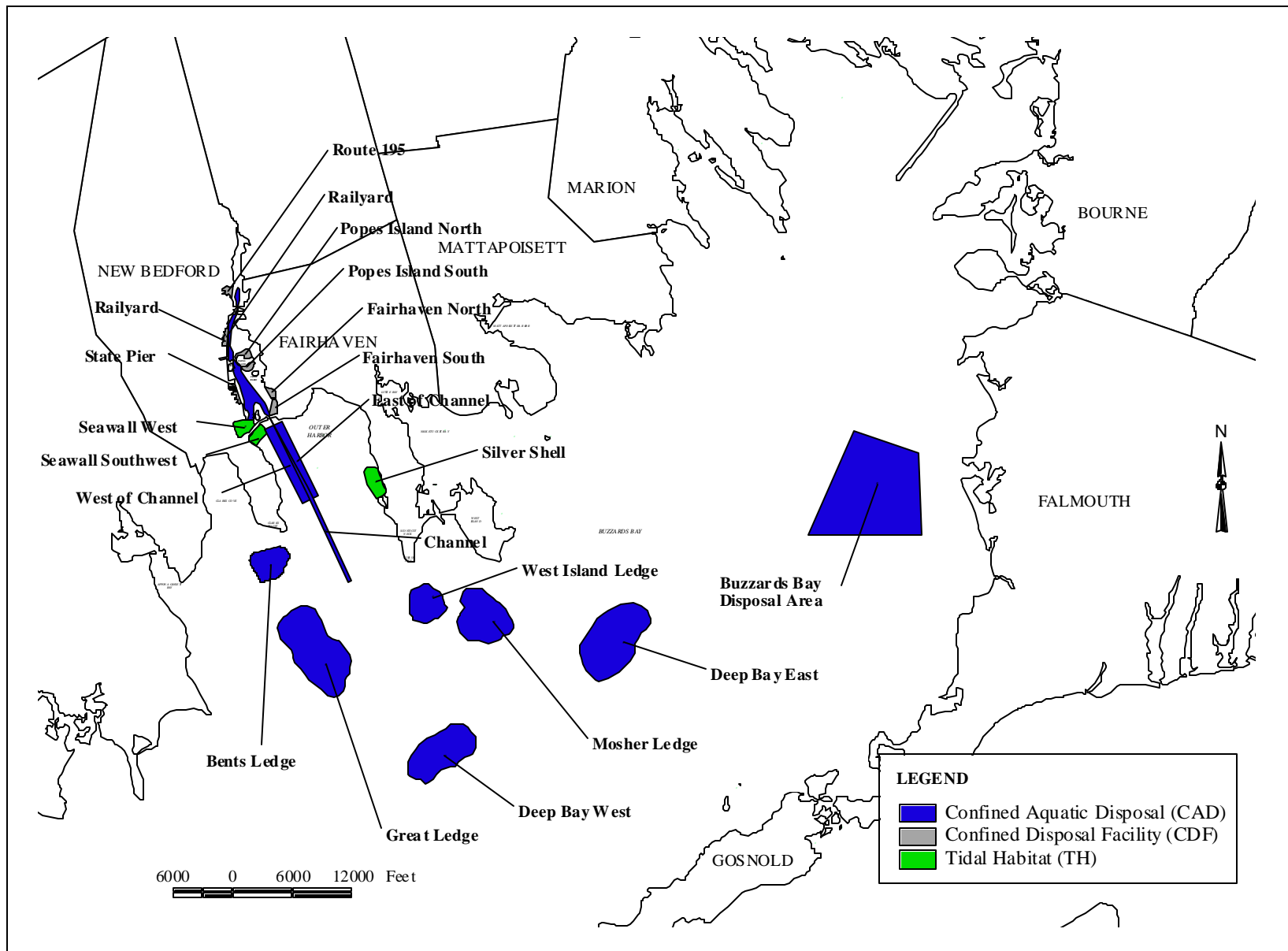
During Phase I of the DMMP, aquatic areas within 10 miles of the lower harbor were investigated to determine which areas may be suitable for dredged material disposal based on physical characteristics alone. For example, sites that are located in seafloor depressions were identified in the outer harbor and Buzzards Bay. Sites within and adjacent-to-channel in the outer, upper and lower harbors were also identified as were developed shorelines areas that had the physical potential for use as CDFs. Using this rationale, a total universe of 20 aquatic disposal sites within the New Bedford/Fairhaven Harbor and a portion of Buzzards Bay were originally identified (Figure 4-15).

After completion of the first phase of the DMMP, the New Bedford/Fairhaven Harbor ZSF was revised. A line was drawn from Wilbur Point to Clarks Point across the outer harbor and all sites south of this line were eliminated. This resulted in the original Phase II universe of 13 sites (Figure 4-16). The seven sites eliminated south of the line were excluded for one or more of the following reasons: 1) sites further into Buzzards Bay have increased wind and wave exposure, therefore containment of UDM in a CAD or capped mound could be problematic; 2) gross sediment mapping of the seafloor indicates that sites further into Buzzards Bay proper have sandy bottoms, which implies an erosional environment; and, 3) sites further in the bay have been less disturbed by man-made forces (dredging, dredged material disposal, wastewater disposal) than sites further inshore.

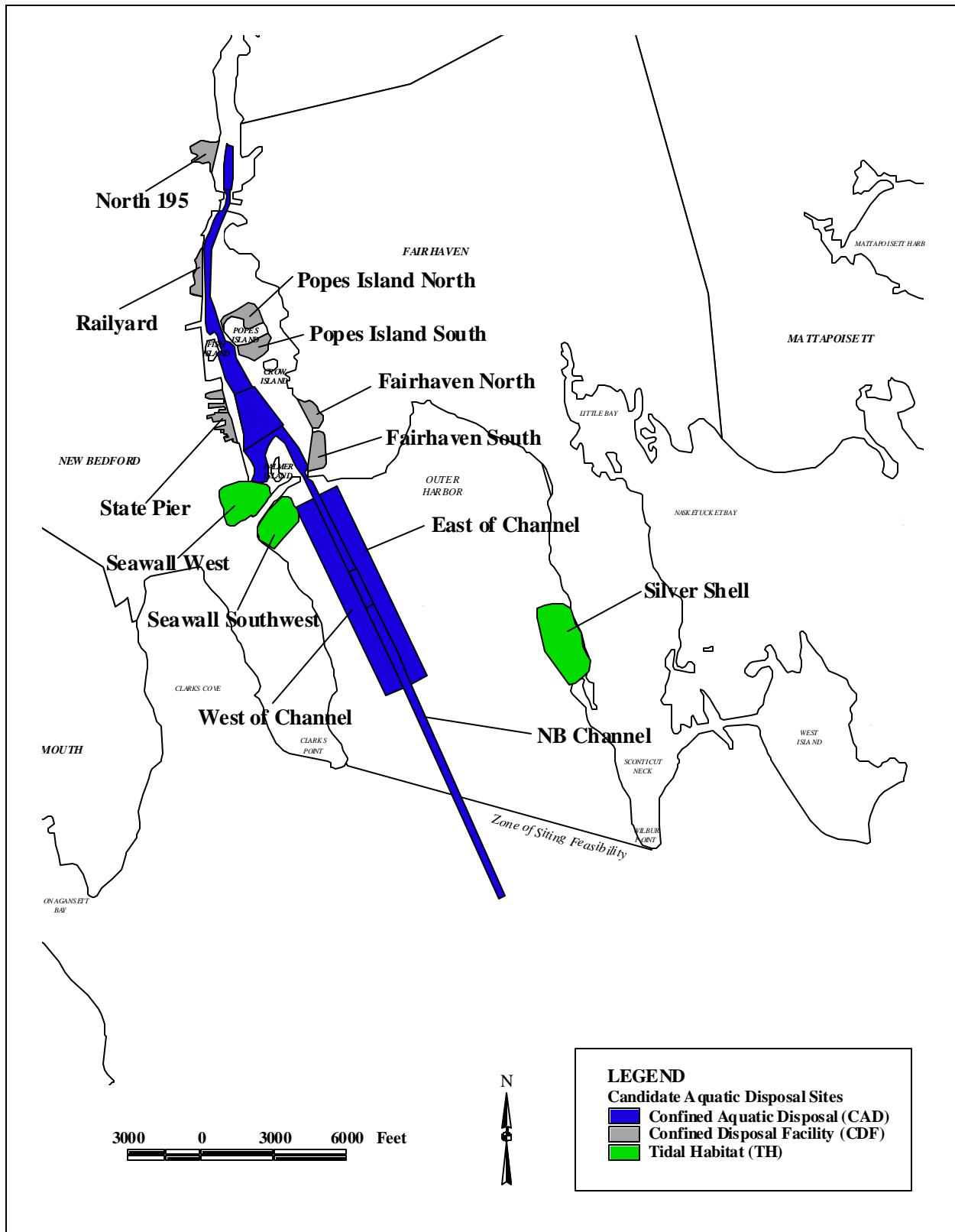
At the request of several federal regulatory agencies, the ZSF for Phase II was further expanded to the southwest to include an area off Clarks Point because this is a potentially degraded area due to the presence of wastewater treatment outfalls. Federal resource agencies then requested that a nearby historic disposal site, West Island Ledge, be included in the universe of sites considered in Phase II. Further changes to the Phase II universe of sites, as a result of coordination with state and local agencies included; revising the name and footprint of the Railyard site to correspond with CDF D under consideration by the USEPA and the City of New Bedford, segmentation of the NB Channel site into three segments, Channel Upper, Channel Inner and Channel Outer and the footprint and disposal type (from CDF to a CAD) for the Popes Island North site. These changes resulted in a net addition of four new sites considered, bringing the total revised Phase II universe to 17 candidate sites (Figure 4-17).

Exclusionary criteria, aimed at eliminating sites based on regulatory prohibition, were applied to the universe of 17 candidate sites. The specific criteria are explained in Section 4.8.2.1. None of the candidate sites failed the exclusionary criteria, therefore all 17 candidate disposal sites were carried forward as potential alternatives.

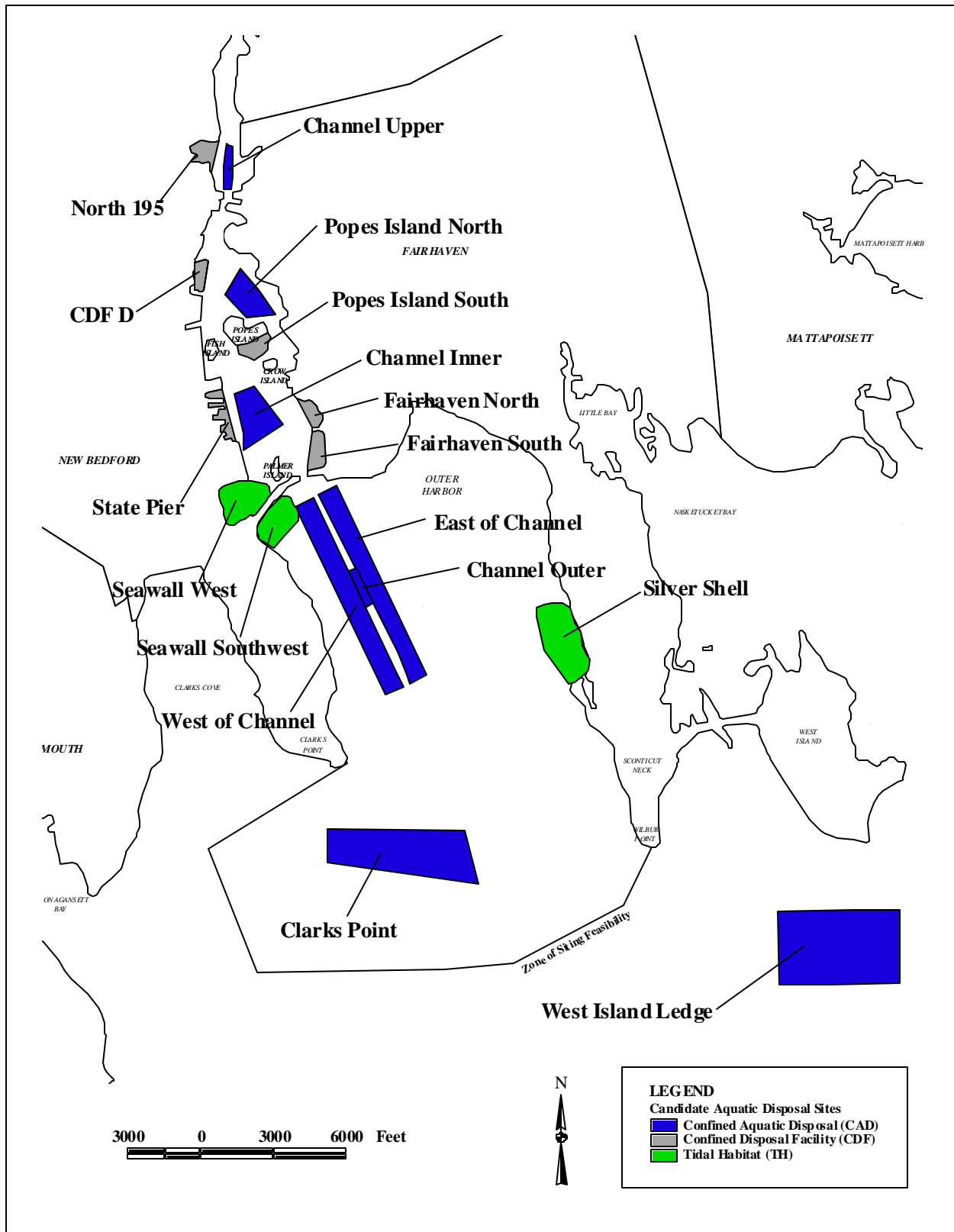




**Figure 4-15: DMMP Phase One Universe of Aquatic Disposal Sites**



**Figure 4-16:** Original ZSF and Candidate Aquatic Disposal Sites



**Figure 4-17:** Expanded ZSF and Candidate Aquatic Disposal Sites

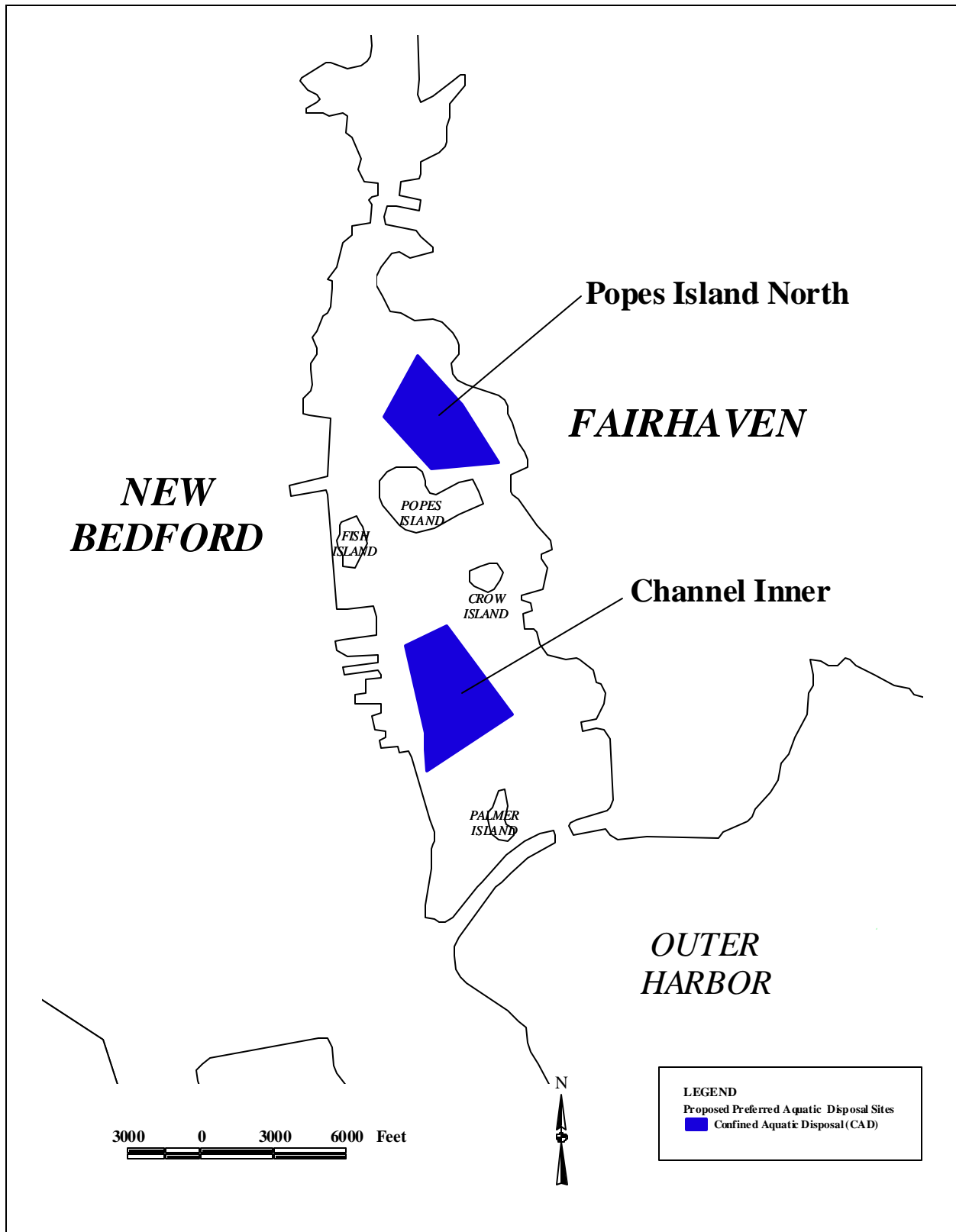
After, these 17 potential disposal sites were evaluated, two sites were selected as proposed preferred alternatives (Figure 4-18). Section 4.8.2 below describes the screening factors that were applied to the 17 potential sites that ultimately resulted in the identification of two proposed preferred alternatives. Section 4.8.3 then presents the screening results and the evaluation of each potential site with respect to the specific screening factors. Then the two proposed preferred alternatives are characterized in greater detail in Section 5.

#### ***4.8.2 Screening Factors***

As discussed earlier, there are two general types of screening criteria, exclusionary and discretionary. Exclusionary criteria are those that would unequivocally prohibit disposal of UDM at a particular site. Exclusionary criteria have a basis in federal or state law. For example, locating a disposal site in an area occupied by an endangered species would be prohibited under the federal Endangered Species Act.

Discretionary criteria are those factors that are used to weigh the relative merits and drawbacks of sites. They do not prohibit use of a site for disposal of UDM, but they do, in total, allow for a comparative analysis of each site, or set of sites, so that a LEDPA can be selected. Discretionary criteria were grouped into the following functional areas: physical, jurisdictional, biological, economic and other.

The screening factors, the goal to be achieved by applying these factors, and the significance of these factors in protecting the environment are listed in Table 4-9 and described below. For each candidate site, a data sheet (Figure 4-19) was completed and distributed to city, state and local groups/agencies. The data sheets contain site specific data collected for the application of the screening criteria. Presentation of the data in this format was used to perform the screening analysis. Data sheets for all the aquatic disposal sites considered are contained in Appendix C.



**Figure 4-18:** Proposed Preferred Disposal Sites

Site Name: _____	Harbor: _____
<b>GENERAL CHARACTERISTICS</b>	
Site Coordinates: _____	Longitude: _____ Latitude: _____
Disposal Type(s): _____	
Total Potential Capacity (cubic yards): _____	
Adjacent Land Use(s): _____	
Provides Capacity For*: _____	
Area	Local      Region
% Capacity _____	
<small>* Based on conservative total volume estimate which assumed 100% unsuitable material plus 20% contingency.</small>	
<b>EXCLUSIONARY USE FACTORS</b>	
Critical Habitat for Federal or State, Rare or Endangered Species:	
State Species:	The natural Heritage and Endangered Species Program (MADFW) is not aware of any rare plants or exemplary communities in the area of this aquatic site.
Federal Species:	NMFS indicates the endangered or threatened species that may be present in the project areas include: Northern right whale, Humpback whale, Fin whale, Leatherback sea turtle, Loggerhead sea turtle, or Kemp's ridley sea turtle. USFWS indicates that with the exception of occasional transient bald eagles or peregrine falcons, no federally-listed or proposed threatened or endangered species under their jurisdiction are known in the project area.
Federal Marine Sanctuaries:	
Name	Distance to Nearest
(mi):	(km):
Comments: _____	
ACEC's (Areas of Critical Concern):	
Name	Distance to Nearest
(mi):	(km):
Historic/Archeological Sites or Districts *:	
Type of Site	Presence      Site Name
(ft):	(m):
<small>* Not listed on the National Register of Historic Places thus considered a Discretionary Factor.</small>	
<b>PHYSICAL CHARACTERISTICS</b>	
Physical Area of Impact (acres): _____	
Average Depth	(ft):      (m):
Site Accessibility:	
Distance:	(mi):      (km):
Logistics: _____	
Routes: _____	

Figure 4-19: Example of Aquatic Disposal Site Data Sheet

<b>Duration of Potential, Adverse Long-term Impacts:</b>			
<b>Duration</b>	<b>Comments</b>		
<b>Navigation/Anchorage:</b>			
<b>Comments</b>			
<b>Current Patterns, Water Circulation:</b>			
<b>Type(s)</b>	<b>Data Source</b>	<b>Mean Surface Current</b>	<b>Mean Bottom Current</b>
<b>Comments:</b>			
<b>Potential for Sediment Resuspension and Erosion:</b>			
<b>Sedimentary Environment</b>	<b>Comments</b>	<b>Potential for Prop Wash</b>	
<b>Ambient Sediment Conditions:</b>			
<b>Grain Size</b>	<b>Existing Quality (based on visual observation)</b>		
<b>Containment Characteristics:</b>			
<b>Type</b>	<b>Concerns</b>	<b>Evaluation</b>	<b>Method</b>
<b>JURISDICTIONAL CONSIDERATIONS</b>			
<b>Wetlands:</b>			
<b>Present w/in 100 ft:</b>	<b>Distance to Nearest</b>		<b>Area of Overlap</b>
(ft):	(m):	(ft <sup>2</sup> ):	(m <sup>2</sup> ):
<b>Wetland type:</b>			
<b>Essential Fish Habitat (EFH):</b>			
* This site has been designated as EFH by the NMFS. See EFH Appendix (1) for more detailed designation information.			

Figure 4-19: Example of Aquatic Disposal Site Data Sheet (continued)

<b>BIOLOGICAL USE FACTORS</b>				
<b>Present Habitat Types:</b>				
Summary Type:				
Impacts:				
Recovery Potential:				
<b>Submerged Aquatic Vegetation:</b>				
Presence	Distance to Nearest	Area of Overlap	Type	
(ft):	(m):	(ft <sup>2</sup> ):	(m <sup>2</sup> ):	
<b>Mudflats:</b>				
Presence	Distance to Nearest	Area of Overlap	Type	
(ft):	(m):	(ft <sup>2</sup> ):	(m <sup>2</sup> ):	
<b>Benthic Habitat:</b>				
Dominant Habitat Type				
Quality				
Heterogeneity				
Benefits				
Impacts				
<b>Summary SPI Data:</b>				
Mean OSI:				
Minimum OSI:				
Maximum OSI:				
Mean RPD:				
Methane Present:				
Low Dissolved Oxygen:				
Dominant Successional Stage:				
Successional Stage(s) Present:				
<b>Shellfish Beds:</b>				
Presence	Distance to Nearest	Area of Overlap	Type	
	(ft):	(m):	(ft <sup>2</sup> ):	(m <sup>2</sup> ):
Type				
* See Shellfish Resources Appendix (2) and Finfish/Invertebrate Species Lists Appendix (3) for more information				

Figure 4-19: Example of Aquatic Disposal Site Data Sheet (continued)



Nursery Habitat*		
Nursery Potential	Habitat Complexity	Species Present (Juveniles)
* See Nursery Habitat Appendix (4) for more information		
<p><b>Spawning Activity*:</b></p> <p><u>Finfish</u></p> <p><u>Invertebrates:</u></p> <p>Lobster spawning generally occurs from May to July. Mollusk spawning activity is limited to areas of known concentrations of mature mollusks and is greatest during July and August.</p> <p>* See Spawning Activity Appendix (5) for more information</p> <p><u>Lobster*:</u></p> <p><u>Marketable Lobster:</u></p> <p><u>Egg-bearing Lobster:</u></p> <p><u>Sub-legal Lobster:</u></p> <p><u>Early Benthic Phase Lobsters:</u></p> <p>* See Lobster Resource Appendix (6) for more information</p> <p><u>Fish*:</u></p> <p>* See Salem Sound 2000 Survey Appendix (7) for more information on inshore sites and MA Trawl Survey Appendix (8) for more information on offshore sites, and ELMR Appendix (9) for both inshore and offshore sites. See Appendix (3) for Finfish Species List</p> <p><b>Diadromous Fish Runs*:</b></p> <p>* See Diadromous Fish Run Appendix (10) for more information</p> <p><b>Waterfowl:</b></p>		
<p><b>ECONOMIC FACTORS</b></p> <p><b>Commercial and Recreational Fisheries*:</b></p> <p><u>Commercial Fishing:</u></p> <p>All potential disposal sites are located in areas closed to mobile gear fishing (e.g. otter trawl, Scottish seine, Danish seine, pair seine, and scallop dredge) year round.</p> <p><u>Gillnetting Activity:</u></p>		

Figure 4-19: Example of Aquatic Disposal Site Data Sheet (continued)

**Commercial Lobstering:**  
 No restrictions within any of the Salem or Salem-Gloucester potential disposal sites. Lobster fishing represents the most valuable single-species fishery in Massachusetts waters.

**Lobstering Activity:** \_\_\_\_\_

**Recreational Fishing:**

Presence	Distance to Nearest		Area of Overlap	
	(ft):	(m):	(ft <sup>2</sup> ):	(m <sup>2</sup> ):
Species: _____	Season: _____			

\* See Commercial and Recreational Fisheries Appendix (11) for more information.

**Water-dependent Recreation:**  
 Type(s) \_\_\_\_\_

**OTHER FACTORS**

Ability to Obtain a Permit: \_\_\_\_\_

Mitigation Potential: \_\_\_\_\_

Consistency with Port Plan: \_\_\_\_\_

Unit Cost of Construction (per cu. yd.) : \$ \_\_\_\_\_

Figure 4-19: Example of Aquatic Disposal Site Data Sheet (continued)

**Table 4-9:** Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Aquatic Disposal

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
<i>Exclusionary Use Factors</i>		
<b>A-1. Rare and Endangered Species / Critical Habitat</b> <b>E</b> - 16 USC 470 <u>et seq.</u> 16 USC 1531 <u>et seq.</u> MGL Chap. 131A 321 CMR 10.60	Amount and quality of habitat, species, time of year occupied	Protect habitat integrity, avoid disturbance during period of use/occupation
<b>A-2. Federal Marine Sanctuaries</b> <b>E</b> - 33 USC 1401	Type, distance, time of year restrictions	Meet Federal requirements
<b>A-3. ACECs (Areas of Critical Environmental Concern)</b> <b>E</b> - 301 CMR 12.00	Type, distance, time of year restrictions	Meet State requirements
<b>A-4. Historic/Archeological Sites or Districts</b> <b>E</b> - Only for designated sites 16 USC 469 MGL Chap. 40C 312 CMR 2.0 - 2.15 <b>D</b> - Non-designated sites	Type of site, presence, significance of features	Protect site integrity
<i>Physical Characteristics</i>		
<b>A-5. Physical Area of Impact</b> <b>D</b>	Size of area affected	Minimize area adversely affected
<b>A-6. Depth</b> <b>D</b>	Depth relative to environmental and navigational use	Protect navigation; maximize containment
<b>A-7. Site Accessibility</b> Route Distance Logistics <b>D</b>	Navigation limitations Length, time to transport Re-handling, storage	Minimize disruptions Maximize efficiency Reduce risks of Re-handling
<b>A-8. Duration of Potential, Adverse Long-term Impacts</b> <b>D</b>	Time, severity, recovery period	Avoid, minimize, mitigate
<b>A-9. Navigation/Anchorage</b> <b>D</b>	Amount, type, draft	Avoid, minimize, mitigate adverse impacts
<b>A-10. Current Patterns, Water Circulation</b> <b>D</b>	Current speed, transport direction	Avoid, minimize, mitigate adverse impacts
<b>A-11. Potential for Sediment Resuspension and Erosion</b> <b>D</b>	Wave heights, direction, fetch	Maximize long-term containment confidence

**Table 4-9:** Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Aquatic Disposal (continued)

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
<b>A-12. Ambient Sediment Conditions</b> <b>D</b>	Grain size, existing quality	Minimize adverse change to existing bottom
<b>A-13. Containment Characteristics</b> <b>D</b>	Currents, grain size, value of adjacent areas	Maximize long-term containment confidence
<b>Jurisdictional Considerations</b>		
<b>A-14.a Wetlands - State Jurisdiction - Massachusetts Wetland Resource Areas including:</b> Coastal or Barrier Beaches, Coastal Bank, Rocky Intertidal Shores, Salt Marshes, Land Containing Shellfish, Banks of or Land Under the Ocean, Ponds Streams, Rivers Lakes or Creeks that Underlie Anadromous/Catadromous Fish Runs <b>D</b>	Amount, type, benefits, impacts, recovery potential	Avoid, minimize, mitigate adverse impacts
<b>A-14.b - Wetlands - Federal Jurisdiction, ACOE Wetlands including:</b> 404(b)1 Wetlands, Mudflats, Submerged Aquatic Vegetation <b>D</b>	Amount, type, benefits, impacts, recovery potential	Avoid, minimize, mitigate adverse impacts
<b>A-14.c - Essential Fish Habitat (EFH)</b> - based upon data from NMFS and DMF as well as DMMP sampling. <b>D</b>	New Bedford/Fairhaven Harbor is designated as EFH under Magnusson-Stevens Act	Avoid, minimize, mitigate adverse impacts

**Table 4-9:** Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Aquatic Disposal (continued)

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
<i>Biological Use Factors</i>		
<i>A-15. Present Habitat Types</i>		
<b>D</b> <i>A-15.a - Submerged Aquatic Vegetation</i>	Amount, type, impacts, distance, recovery potential	Avoid, minimize, mitigate adverse impacts
<b>D</b> <i>A-15b. - Mudflats</i>	Amount, type, impacts, distance, recovery potential	Avoid, minimize, mitigate adverse impacts
<b>D</b> <i>A-15c.-Benthic Habitat</i>	Habitat type, quality, heterogeneity, recovery potential, time of year issues	Avoid, minimize, mitigate adverse impacts
<b>D</b> <i>A-15.d - Shellfish beds</i>	Habitat type, quality, heterogeneity, recovery potential, time of year issues	Avoid, minimize, mitigate adverse impacts
<b>D</b> <i>A-15.e - Nursery and Spawning Potential</i>	Amount, type, benefits, impacts, recovery potential, distance, time of year issues	Avoid, minimize, mitigate adverse impacts
<b>D</b> <i>A-15f - Fish</i>	Abundance, benefits, impacts, recovery potential, time of year issues	Avoid, minimize, mitigate adverse impacts
<b>D</b> <i>A-15g - Waterfowl</i>	Amount, type, time of year issues	Avoid, minimize, mitigate adverse impacts
<i>Economic Factors</i>		
<i>A-16. Commercial and Recreational Fisheries</i> <b>D</b>	Amount, type, quality	Avoid or minimize loss and long-term impacts
<i>A-17. Water-dependent Recreation</i> <b>D</b>	Amount, type, quality	Maximize retention of opportunities
<i>Regulatory/Practicability/Human Factors</i>		
<i>A-18. Ability to Obtain Permit</i> <b>D</b>	Consistency with federal and state regulations	Meet all federal and state guidelines for permits
<i>A-19. Mitigation Potential</i> <b>D</b>	Amount, type of mitigation required/possible through site use.	Maximize potential for mitigation of existing degraded habitats
<i>A-20. Consistency with Port Plan</i> <b>D</b>	Values and site-specific uses in port plan	Maximize consistency with port plans
<i>A-21. Cost</i> <b>D</b>	Estimated 20-year cost of construction and maintenance, including monitoring	Minimize long-term costs

#### 4.8.2.1 Exclusionary Criteria

**A-1. Rare and Endangered Species** (Critical habitat or resource-use area for federal or state listed threatened or endangered species or species of concern) - The locations of the sites identified in the initial screening were provided to the U.S. Fish and Wildlife Service and National Marine Fisheries Service for threatened and endangered species review. The locations were also provided to Massachusetts Department of Environmental Management for review of state listed species.

Disposal of UDM at a site located within a threatened or endangered species habitat would likely be prohibited under the federal Endangered Species Act.

**A-2. Historic/Archeological Sites or Districts** - The sites were evaluated for potential cultural resource constraints through consultation with the Massachusetts State Historic Preservation Office and review of positions of shipwrecks and artifacts of maritime history.

Disposal of UDM at a significant historic or archaeological site could be prohibited. However, the determination of significance would be made by the Massachusetts Historic Preservation Office in consultation with the Bureau of Underwater Archaeology. If a site is deemed not significant, or if mitigation measures such as recovery and recordation can be implemented, then the presence of an historical or archaeological resource may not exclude the site from accepting UDM.

**A-3. Federal Marine Sanctuaries** - Sites were evaluated by comparing their locations (and any potential drift of suspended material) to the boundaries of nearby National Marine Sanctuaries.

**A-4. ACECs** (Areas of Critical Environmental Concern) - Sites were evaluated by comparing their locations (and any potential drift of suspended material) to the boundaries of any ACECs identified by Mass GIS.

ACECs are areas designated by the Commonwealth as having unique environmental features. There are no ACECs within the New Bedford/Fairhaven ZSF. The nearest ACEC is the Black River Estuary and Pocasset River sites located approximately 15 miles east of New Bedford/Fairhaven Harbor in Bourne, MA.

#### 4.8.2.2 Discretionary Criteria

**A-5. Site Accessibility** - Accessibility is determined by the following factors: Route: The most practical route for tugs and barges for transit to and from the dredging area and disposal site. Distance: The distance based on the practical route was calculated from the head of navigation of the proposed dredging project. Logistics: Any potential logistical problems that might be encountered in use or construction of the proposed site.

The site accessibility factors are important in maximizing dredging and disposal efficiency by minimizing disruption and sediment re-handling.

**A-6. Physical Area of Impact** - The amount of sea floor in acres that would be directly affected by

disposal activities was estimated. A smaller footprint of disturbance is preferred over a larger footprint, therefore, sites that could be excavated to deeper depths would be preferred over sites that have excavation limitations due to presence of bedrock or other material that is difficult to dredge.

**A-7. Duration of Potential, Adverse Long-term Impacts** - Recovery time is a function of the type of disposal and site conditions (e.g. constructed, level bottom). The relative length of recovery is estimated in the following manner:

*Short Term:* sites with sediment size similar to material to be dredged with little or no construction required are most preferred.

*Intermediate:* sites with different grain size or construction required are less preferred.

*Potential Long Term:* sites with potential non-recoverable long term effects (e.g. altering fish migration routes) are least preferred.

**A-8. Navigation/Anchorage** - The proximity and depth relative to shipping lanes, designated channels and anchorages. Sites located within existing channels or anchorage areas would be less preferred over areas not utilized for navigation. Shallow areas, generally less than 20 ft. MLW, are least preferred due to potential access problems for excavation equipment.

### **A-9. Present Habitat Types**

A-9.a - Wetlands - State Jurisdiction - Wetlands as defined in the Massachusetts Wetlands Protection Act (M.G.L Ch. 131, Section 40) and the DEP Wetland Regulations (310 CMR 10.00). Sites located within or near (and potentially impacting) the MA DEP Natural Resource Areas are less preferable than those outside of and distant from these resource areas. MA DEP Natural Resource Areas include: Coastal or Barrier Beaches, Coastal Bank, Rocky Intertidal Shores, Salt Marshes, Land Containing Shellfish, Banks of or Land Under the Ocean, Ponds, Streams, Rivers Lakes or Creeks that Underlie Anadromous/Catadromous Fish Runs.

A-9.b - Wetlands - Federal Jurisdiction - Wetlands as defined in the CWA. As listed in Section 404(b)(1) wetlands, mudflats, and submerged aquatic vegetation (SAV) are given special consideration. Mudflats are Special Aquatic Sites under CWA 4-1(b) guidelines and include any intertidal areas with organic material and grain size less than sand. Sites distal to these resources are preferred over sites within or proximal to these wetland resources.

A-9.c - Spawning/Nursery Habitat - Spawning or nursery habitats for finfish. Sites within or near these habitats, as identified by Massachusetts DMF and other sources, are discouraged.

A-9.d - Shellfish Beds - Sites within or near areas of shellfish concentration, as indicated by DMF and other available sources, are least preferred.

A-9.e - Benthic Habitat - Sites are preferred in areas where benthic community and overall habitat quality is poorest. Each site was evaluated through the use of REMOTS® sediment profile imaging. The REMOTS® data were used to assess the number of habitats present, the quality based on the Organism Sediment Index (OSI) of the benthic habitat and the general context of the site relative to other sites. In general the preference was to locate disposal sites in substrates that contain homogeneous, soft sediments with low OSI quality rather than hard sandy substrates or sites with multiple habitat types and high OSI quality.

A-9.f - Essential Fish Habitat (EFH) - The evaluation of EFH is based upon data provided by the NMFS and DMF as well as sampling conducted within New Bedford/Fairhaven Harbor for this DMMP EIR. All of New Bedford/Fairhaven Harbor is designated as EFH under the Magnusson-Stevens Act.

**A-10. Avifauna** - The presence, timing and concentration of avifauna. Through consultation with the Massachusetts Department of Fish and Wildlife, USFWS and literature sources, avifauna (i.e.: shorebirds, waterfowl, seabird habitat) was reviewed. Sites furthest from known avifauna concentration areas, particularly nesting islands, are preferred.

**A-11. Current Patterns, Water Circulation** - Currents and water circulation patterns can affect the movement of deposited UDM. Sites are preferred in areas where currents, particularly bottom currents, are low so as to minimize the erosion potential to UDM or capping.

**A-12. Exposure to Erosive Currents, and Storm Waves** - The effect of currents, both tidal and storm-induced, can affect the movement of sediments. UDM disposal in areas where bottom currents from various hydrodynamic forces are low is preferred over areas of potential high velocity (i.e., erosive) currents. Erosion potential was evaluated based on coastal bathymetric charts, determination of fetch, local knowledge, and published information on grain size (Knebel et al., 1998).

**A-13. Commercial and Recreational Fisheries** - DMF reviewed proposed sites relative to existing data on commercial and recreational fisheries and evaluated local knowledge provided through the Harbor Committees. Areas that are not fished, commercially or recreationally, are preferred over those that are actively fished.

**A-14. Water-dependent Recreation** - These activities include: fishing, boating, scuba diving, swimming. Sites are preferred in areas with little or no recreational activity.

**A-15. Ambient Sediment Conditions** - Estimated sediment type will be recorded from REMOTS® data. Similar to A-9.e, areas where sediment is similar to that of the UDM to be placed there, (i.e. soft, silty and homogenous), are preferred over areas where ambient sediment is coarse-grained or mixed.



**A-16. Depth** - The existing depths of the disposal sites were obtained from bathymetric surveys or NOAA charts. Final depths after construction or fill were estimated from this available existing depth data. Sites located in shallow water, generally less than 20 feet, are less preferable than deeper sites, because of potential keel clearance of dredging/disposal equipment.

**A-17. Containment Characteristics** - The depth and bathymetry (existing or after construction) were evaluated to assess containment characteristics. Sites located within existing depressional areas, where “natural” bathymetric contours provide containment are preferred over level or sloping areas where containment would be more difficult.

**A-18. Ability to Obtain Permit** - Each proposed disposal site was reviewed for consistency with federal and state regulatory guidelines to determine potential for obtaining a permit under existing guidelines. Sites that have a higher potential for meeting all state and federal laws, policies and regulations are preferred.

**A-19. Mitigation Potential** - The characteristics of the proposed site (e.g. location, existing habitat, future uses) were evaluated for either loss of habitat, or conversely, potential to add habitat through site design. The feasibility of habitat restoration mitigation measures would be assessed if habitat loss was found to be likely. If habitat restoration was determined to be a possible solution, then the feasibility of mitigation activities would be evaluated. Sites that require the least amount of mitigation activities in terms of size, time, and cost are preferred.

**A-20. Consistency with Port Plan** - Each proposed disposal site was reviewed by the New Bedford/Fairhaven Harbor Dredging Subcommittee for consistency with the New Bedford Harbor Plan, specifically to determine whether the sites enhance the values articulated in the Port Plan and conform to projected site-specific uses. Sites that enhance the Port Plan recommendations are preferred over those that conflict with the Port Plan.

**A-21. Cost** - The cost of the construction, maintenance, and monitoring of each proposed site was estimated on a twenty-year planning cycle for comparative purposes. Sites that are least costly are preferred over sites that have higher costs.

### ***4.8.3 Screening Results***

As discussed earlier, 17 potential disposal sites were subjected to further screening. In order to distinguish among these sites, the screening factors described in Section 4.8.2 above, were applied. In many cases, groups of sites were compared because there were no significant differences in physical or biological characteristics between the individual sites.

The evaluation of the 17 potential disposal sites with respect to the discretionary screening factors is discussed below based on five general groupings: exclusionary, physical, jurisdictional, biological and economic factors.

The physical factors include: capacity, physical area of impact (A-6), site accessibility (A-5), navigation/anchorage (A-8), current patterns/water circulation (A-11), potential for sediment resuspension and erosion (A-12), ambient sediment conditions (A-15), depth (A-16), containment characteristics (A-17), and duration of potential adverse long-term impacts (A-7).

The exclusionary factors include: threatened and endangered species/critical habitat (A-1), federal marine sanctuaries (A-3), and ACECs (A-4). The biological factors are habitat types (A-9) and avifauna (A-10) and commercial and recreational fisheries (A-13) represent the economic factors.

Regulatory/Practicability/Human factors include: historical/archaeological sites or districts (A-2), water-dependent recreation (A-14), ability to obtain permit (A-18), mitigation potential (A-19), consistency with port plan (A-20), and cost (A-21).

#### 4.8.3.1 Exclusionary Factors

Exclusionary criteria, aimed at eliminating sites based on regulatory prohibition, were applied to the universe of 17 candidate sites. None of the candidate sites failed the exclusionary criteria, therefore all 17 candidate disposal sites were carried forward as potential alternatives and the remaining four factor groupings were applied as described below.

#### 4.8.3.2 Physical Factors

Site capacity was an important consideration as it determines whether a single site or multiple sites would be needed to confine the material requiring dredging (Maguire Group Inc., 1997a). There were two interdependent elements of site capacity: area and UDM thickness. For example, 400,000 cy of UDM would cover 400 acres to 1 foot in depth; 40 acres to 10 feet of depth; or 20 acres to 20 feet of depth. Given the anticipated volumes of UDM, the use of UDM for creation of land, wetland, or tidal mudflat would be most practical at water depths of less than 20 feet MLW. Bottom disposal in the relatively exposed Buzzards Bay may require depths greater than 20 feet for maximum protection against storm driven waves.

Tables 4-10 shows the potential capacities of each site to accept UDM. Of the 17 potential sites, nine (9) sites, West of Channel, East of Channel, Channel Inner, Popes Island North, Seawall Southwest, Seawall West, Silver Shell, West Island Ledge, and Clark's Point have the capacity to accept all of the UDM from New Bedford/Fairhaven Harbor over the next 10 years. The remaining aquatic disposal alternatives would have insufficient capacity to accommodate 100 percent of UDM. Therefore, if one of these sites were used, then another site would have to be used in conjunction to satisfy the capacity requirement.

**Table 4-10:** Characteristics of Potential Aquatic Disposal Sites in New Bedford/Fairhaven Harbor

Site Name	Type	Average Water Depth (Feet)	Size (Acres)	Potential Capacity <sup>1</sup> (x 1000 c.y.)	Distance To Project <sup>2</sup> (Miles)
West of Channel	CAD/ATC	18	162	6,214	3.3
East of Channel	CAD/ATC	16	140	4,396	3.3
Channel Inner	CAD/OD	28	60	1,223	1.8
Channel Outer	CAD/OD	24	12	364	3.3
Channel Upper	CAD/OD	10	14	454	0.5
Popes Island North	CAD	6	40	3,266	0.9
North 195	CDF	2	20	656	0.7
CDF D	CDF	4	14	442	0.6
Popes Island South	CDF	8	19	599	1.5
State Pier South	CDF	20	15	492	1.9
Seawall Southwest	CDF/TH	10	51	1,660	2.9
Seawall West	CDF/TH	3	61	1,976	2.5
Silver Shell	CDF/TH	5	102	3,298	5.3
Fairhaven North	CDF	5	10	225	2.2
Fairhaven South	CDF	4	21	694	2.4
West Island Ledge	CAD	25	349	14,090	8.7
Clark's Point	CAD	29	238	11,524	5.1

<sup>1</sup> These capacity calculations were based on the sum of maximum capacities estimated for candidate site sub-areas. All volumes are based on a 3:1 slope. Maximum capacity was calculated using the average basement depth (Maguire 1999).

<sup>2</sup> As measured from the center of the lower harbor

Site accessibility was considered with respect to the candidate sites. The two off-shore sites are more distant from the dredging projects than most sites within the Harbor with the exception of the Silver Shell CDF/TH. Off-shore disposal site distances range from 5.1 to 8.7 miles from the dredging areas. Sites within New Bedford/Fairhaven Harbor are within 0.6 to 5.3 miles from the dredging areas.

Sites located in New Bedford/Fairhaven Harbor are within and/or near existing navigation areas. West of Channel and East of Channel are CAD/ATC sites that are located adjacent to the federal navigation channel within the Outer Harbor. The Inner Harbor Channel Site is located adjacent to federal channels and commonly-used navigation areas for recreational vessels. All off-shore sites are outside of designated navigation channels.

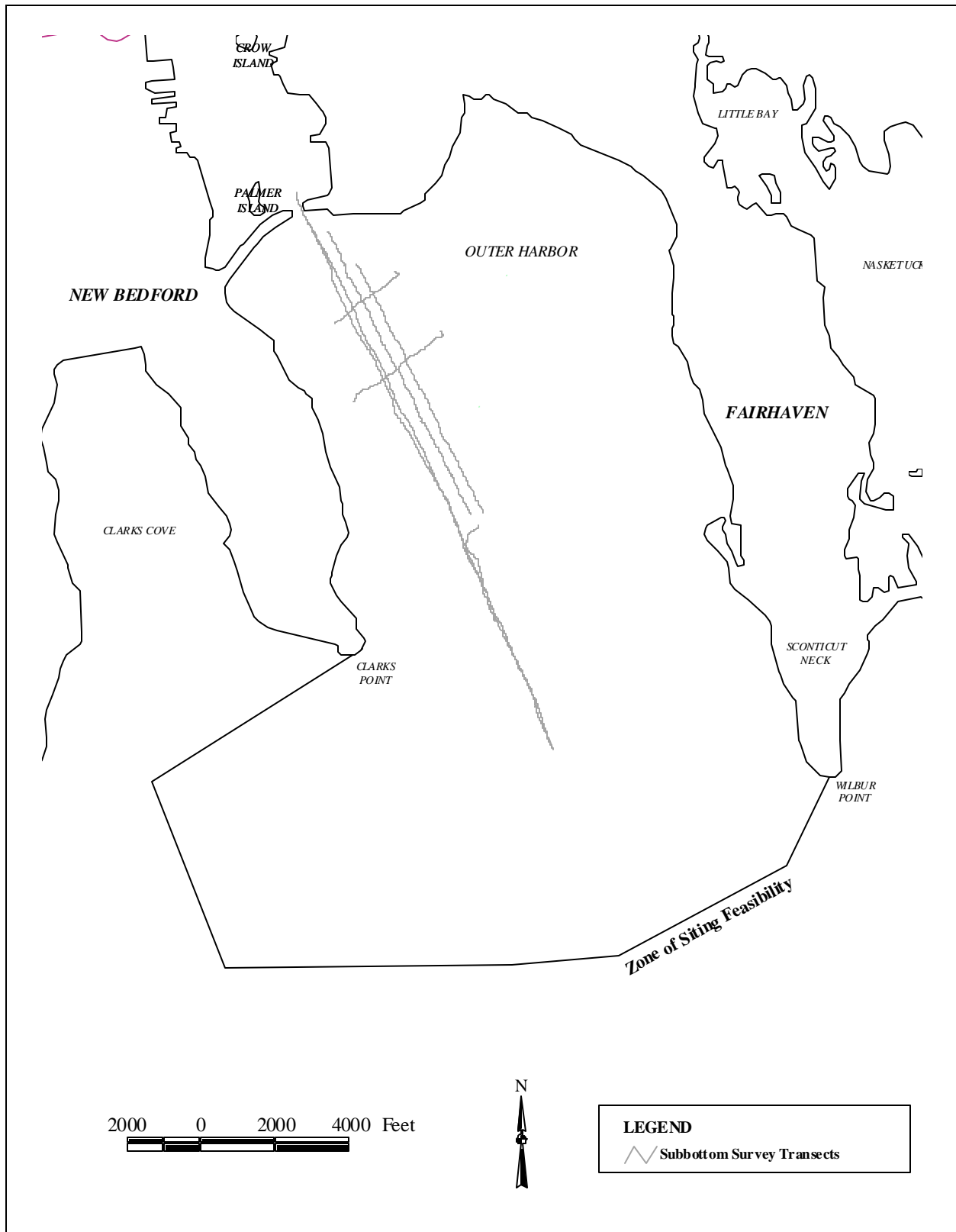
Depths for the candidate sites ranged from 2 to 29 feet deep. The Outer Harbor and off-shore sites are considerably deeper than the Upper and Lower Harbor sites. The shallowest sites are near-shore or within the Upper Harbor where the depth to bottom is variable and can be as low as 2 feet in some locations. These shallow sites would have to be constructed as CDFs or excavated CADs.

The physical area of impact is an important factor in evaluating disposal sites. Because most of the biological activity in sediment is within the upper 2 feet, it is important to limit the disturbance to as small a footprint as possible. For example, a disposal area that is relatively small in area, with a large cell depth, is preferred over a site that is relatively large in area, but has a shallow cell depth.

The physical area of impact is a function of many variables: the volume of UDM, the type of disposal site (e.g.: CAD-mound, CAD-pit, CDF, TH), depth to bedrock, site configuration, side-slope, surrounding bathymetry, disposal timing and sequencing are all important factors. Because there are so many variables and assumptions involved in the calculation of physical impact area, the direct comparison of these values for each candidate sites would not be appropriate. Rather, the discriminating factor in determining physical area of impact, particularly for sites in the Harbor, is the depth to bedrock. Sub-bottom profile surveying was done to determine the depth to bedrock for New Bedford/Fairhaven Harbor sites. Sub-bottom profiling is a standard technique used for distinguishing and measuring various sediment layers that exist below the sediment/water interface. Sub-bottom systems are able to distinguish sediment layers by measuring differences in acoustic impedance between the layers. A sub-bottom system uses the energy reflected from these boundary layers to build an image of the existing environment.

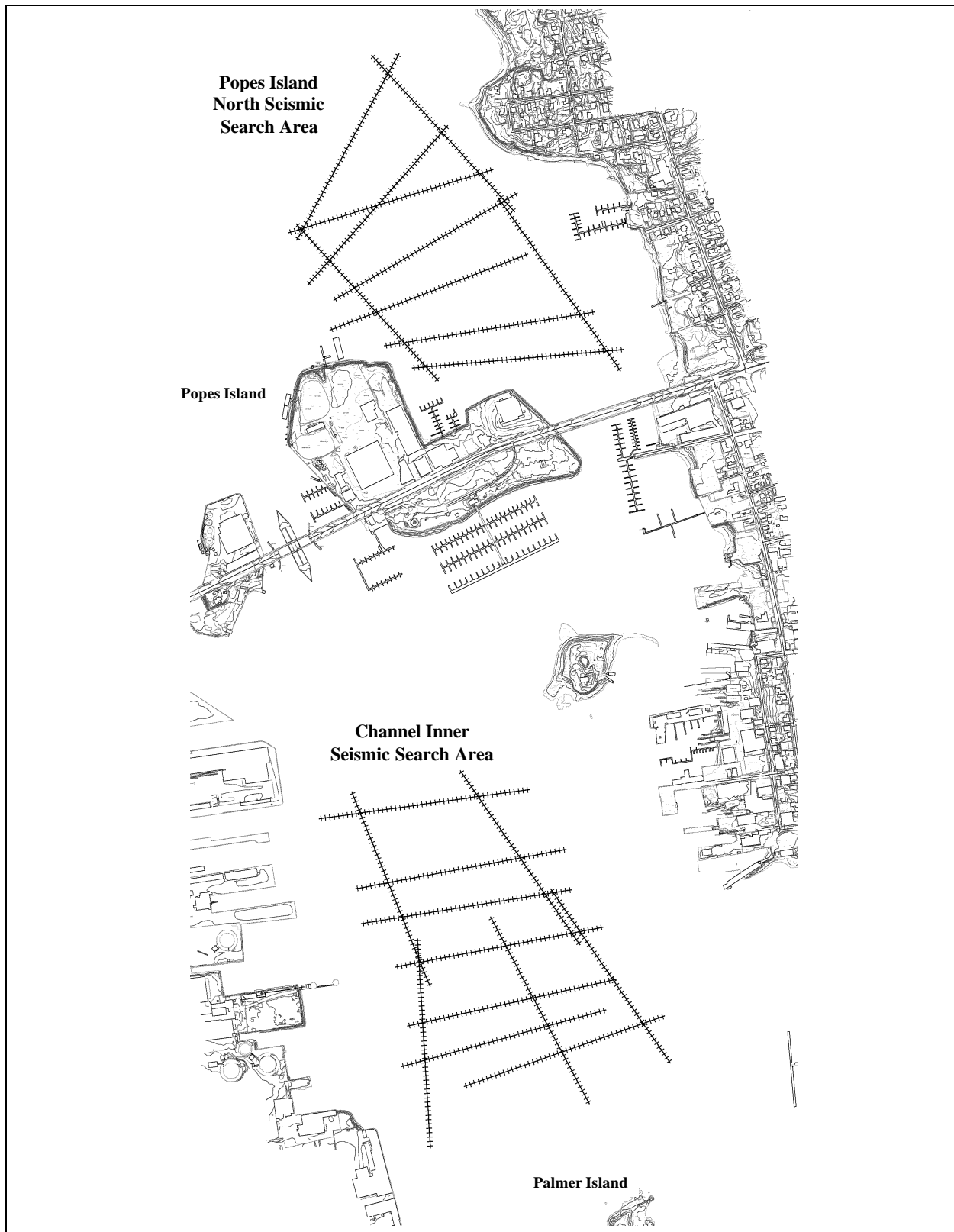
Survey transects were run throughout the lower harbor and outer harbor potential sites (Figure 4-20). However, data from the lower harbor and some areas of the outer harbor channel were difficult to reliably contour because of the presence of gases within the shallow water survey area, potential sound loss due to layers of coarse glacial sediments and methane layers. An additional geophysical investigation was conducted to contour the Inner Harbor.

A marine seismic refraction survey consisting of a number of seismic lines, or “spreads”, designed to cover Inner Harbor locations was conducted (Figure 4-21). Small seismic charges were emplaced into the sediment of the harbor bottom to provide seismic energy. The sound returns as a result of the seismic shots were input into a model to determine the depth to bedrock in the sample areas (Appendix J).



**Figure 4-20:** Outer Harbor Sub-bottom Survey Transects

Depth to bedrock varies within New Bedford/Fairhaven Inner and Outer Harbor areas (Figures 4-22 and



**Figure 4-21:** Inner Harbor Marine Seismic Refraction Spreads

4-23). Within the East of Channel CAD/ATC site, depth to bedrock ranges from 5 to 14 m below the sediment surface. The West of Channel ATC site in the Outer Harbor has slightly more sediment overburden, with average depth to bedrock from about 6 to 18 meters.

The CAD/OD areas in the Inner Harbor are considerably more shallow than the CAD/ATC areas within the Outer Harbor. Therefore 960,000 cy of UDM deposited in the New Bedford/Fairhaven Outer Harbor CAD sites would result in less physical area of impact than if that same volume of UDM were deposited in Inner or Lower Harbor CDF sites, because of the suspected inner harbor's relatively shallower depths to bedrock.

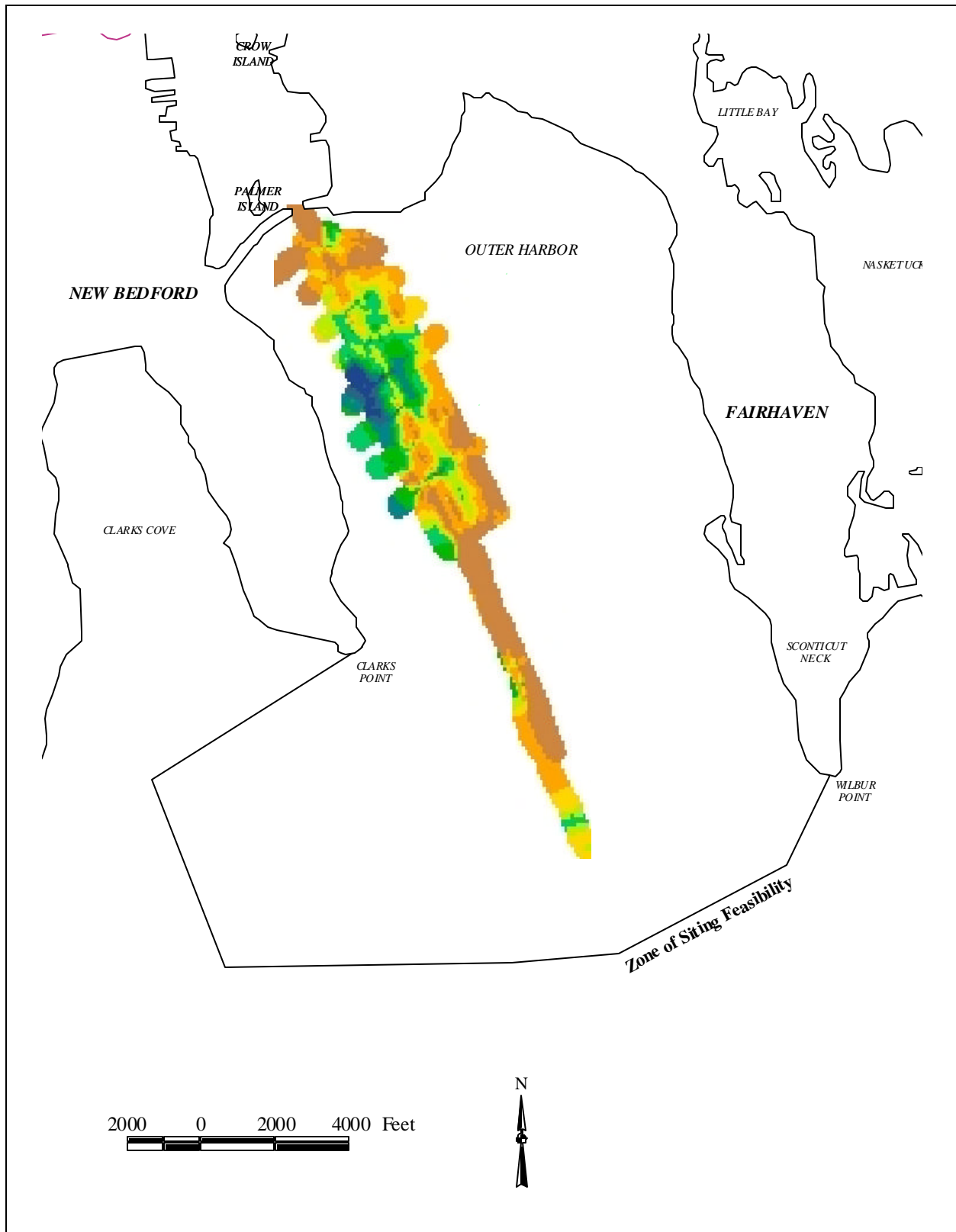
The channel and adjacent-to-channel CAD cells generally have deeper depth to bedrock than other areas of the Harbor channel and adjacent-to-channel sites where depth to bedrock was typically recorded at <3 feet below the sediment surface .

Available literature on the depth to bedrock at the off-shore West Island Ledge CAD site, suggests that bedrock may lie from 3-6 feet below the sediment surface. At Clark's Point Aquatic Disposal site, the depth to bedrock may be as deep as 9-12 feet. Therefore, the Clark's point disposal site would be expected to be constructed with a smaller footprint due to the deeper potential depth of the pit. Both sites have adequate capacity to accommodate the 2.6 million cy of UDM expected to be dredged from New Bedford/Fairhaven Harbor.

Currents have the potential to resuspend surficial sediments, which may be re-deposited in areas where the current velocity decreases. Generally speaking, fine grained sediments, such as silts and clays, are found in water with slow currents that often produce depositional areas. While coarse-grained sediments, such as sand and gravel, exist in areas where current speeds are relatively high and erosional areas are more likely. Areas of mixed fine and coarse-grained sediments are considered transitional areas or sediment reworking areas. Therefore, patterns of currents can be inferred from the mapping of sediment types provided by Moore (1963) and Summerhayes et. al. (1985) (Figure 4-24). This type of analysis, however, only offers a broad view of the hydrodynamic characteristics of the candidate sites. For instance, all of New Bedford Harbor and Buzzard's Bay in general are considered net depositional areas due to landward movement of water and its sediment load in the lower water column (CDM, 1989). However, data specific to the West Island Ledge offshore aquatic site (i.e. the presence of large grain sizes), suggests that this site specific location is an erosional environment.

In order to further define the sediment conditions from which we can infer current energy and to distinguish each site based upon sediment conditions, sediment profile imaging surveys were conducted at each of the candidate aquatic disposal sites. The composition of the existing sediments at the New Bedford/Fairhaven Harbor and off-shore sites is discussed below.

The existing character of the sediment was sampled during the DMMP Phase 1 Study (Maguire Group, 1997) and the habitat characterization study (SAIC, 1999a).



**Figure 4-22:** Outer Harbor Depth to Bedrock



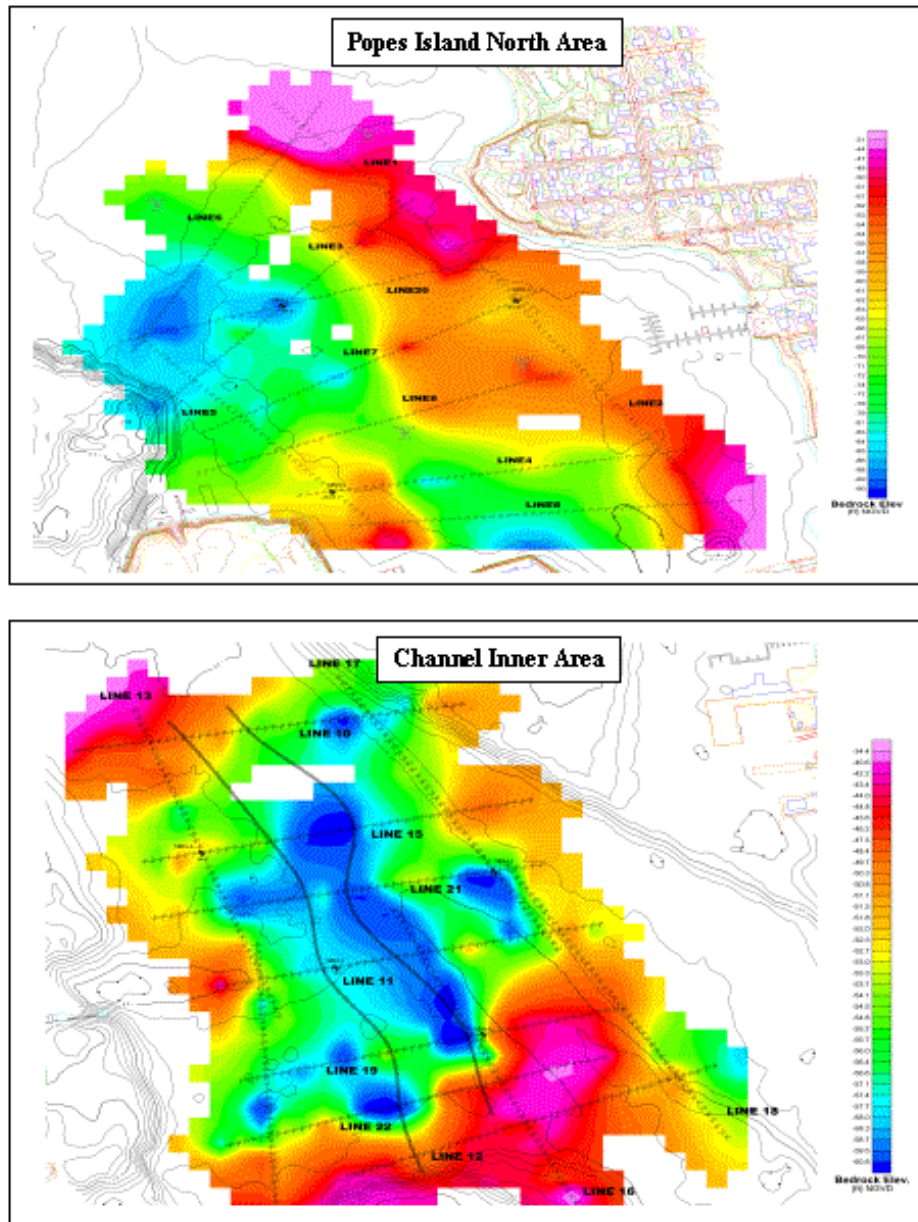


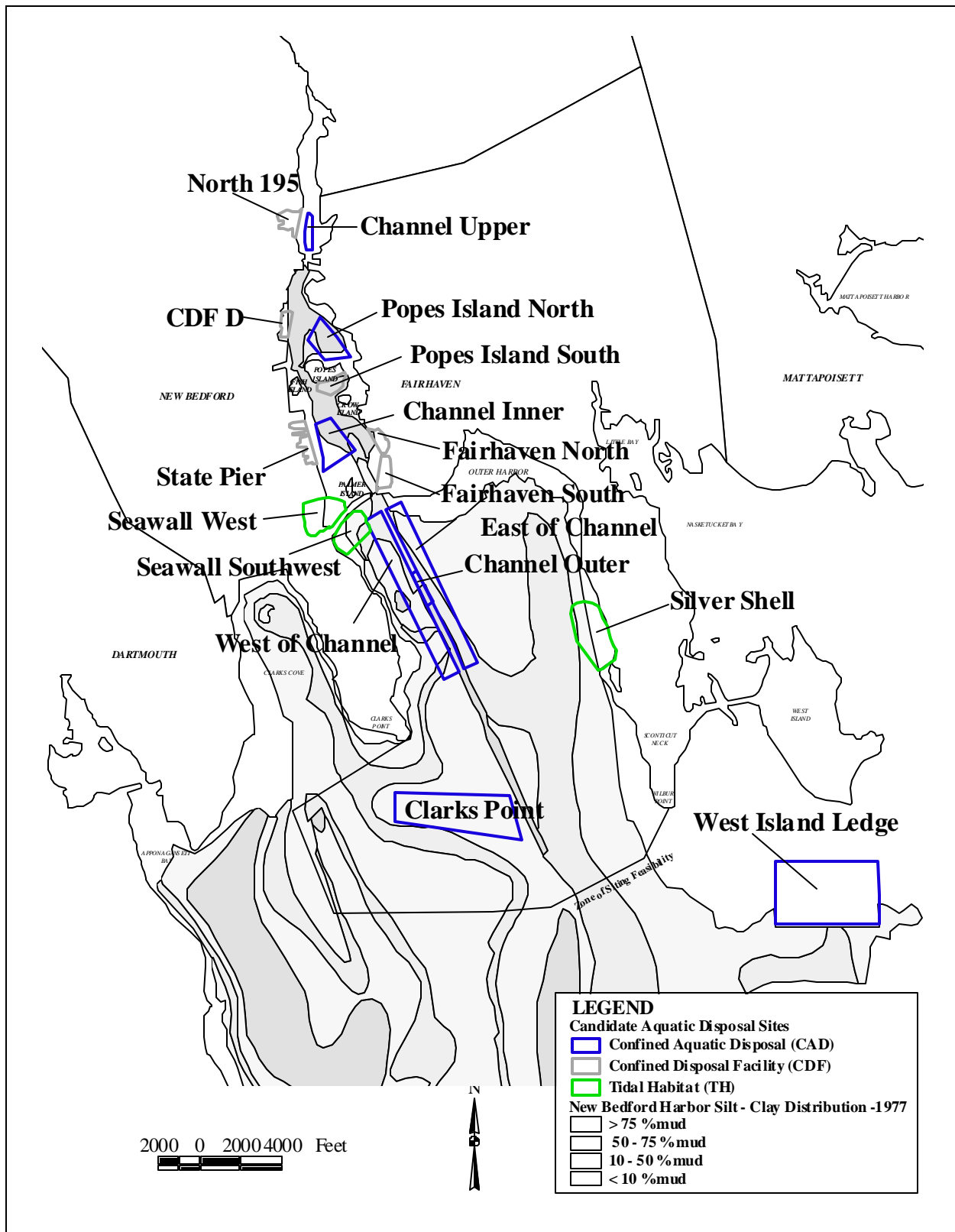
Figure 4-23: Inner Harbor Depth to Bedrock

Fine-grained sediments ( $>4$  phi), such as silts and clays, dominate the New Bedford/Fairhaven Channel and Popes Island South potential alternative aquatic disposal sites in New Bedford/Fairhaven Harbor. This type of sediment suggests a low-energy, depositional environment. Very fine sand sediments (4-3 phi) were found within much of Seawall Southwest, Fairhaven South, and Pope's Island North sites. The west of Channel, State Pier, and Railyard sites were also predominantly fine-grained ( $>4$  or 4-3 phi) but also contained areas of hard bottom (rocks). The East of Channel site had predominantly silt-clay ( $>4$  phi) sediments, but medium and very coarse sand areas also exist. Largest grain-sizes (hard, medium to fine sand) with some pebbles and shells was found within the Silver Shell site. Other limited areas found within the alternative aquatic disposal sites, consisted of fine sand or bedrock. Off-shore sites are more variable, although they generally contain sediments that are more coarse grained than harbor sediments (Figure 4-24).

Other physical and biological parameters were evaluated using sediment profile imaging to provide further insight into the sediment character. The Redox Potential Discontinuity (RPD) is the depth of oxygenation into the sediment. It is determined via REMOTS® sampling which involves pushing a camera into the sediment and photographing the sediment profile. The abrupt change in color from lighter oxygenated sediments to darker hypoxic or anoxic sediment is known as the RPD. Higher RPD depths indicate more oxygen in the sediment. Many New Bedford/Fairhaven Harbor sites showed intermediate RPD depths (1-3 cm), indicating poor to fair sediment aeration, probably due to moderate to high levels of organic loading in New Bedford/Fairhaven Harbor. The highest RPD values ( $>3$  cm) were measured from three images taken within NB-Channel and one image from East of Channel.

Due to poor camera penetration, the RPD could not be determined at a number of sampling locations within the harbor. Namely: the south end of the West of Channel Site; the north end of Silver Shell site; the north end of the State Pier site; the vicinity of the west end of the Seawall West site; the Seawall southwest site and the north end of East of Channel.

Sediment profile images could not be obtained from a number of sampling areas due to inhibition of camera penetration by rocks, shells, or other hard bottom substrate. Most of the images obtained from penetrable areas exhibited Stage I communities. The patterns of infaunal successional stages were consistent with the results of the RPD indices at these harbor sites. Only three images depicted evidence of Stage III organisms: one from NB Channel, one from East of Channel, and one from Pope's Island South site. Within the Outer Channel area, sediments were found to include mixtures of gravel, sand, and mud at various proportions. The highest proportion of fine-grained sediment ( $>75\%$  silt-clay) was found within the shipping channel, while the area immediately west of the shipping channel had somewhat lower proportions of silt-clay. Outside of these areas, sediments generally contained less than 50% silt-clay. The vicinity of Station 139 in the Outer Shipping channel showed fine-grained sediments. Much of the area within the Outer Channel area therefore appears to be moderately depositional. An area where maximum sub-bottom capacity could be configured was chosen as a CAD site (Clark's Point CAD), because of significant depth to bedrock and because it was a sediment deposition zone.



**Figure 4-24:** Silt-Clay Percentages of Surficial Sediments in Harbor and Buzzards Bay (Summerhayes et al, 1985)

The area offshore of New Bedford/Fairhaven in Buzzard's Bay is characterized by a wide variety of sediments, ranging from those dominated by silt and clay, to sand, gravel, and rocks. Data specific to the offshore disposal sites demonstrated this variability. Sediment samples collected from within the West Island Ledge disposal site boundaries were comprised of less than 10% silt-clay. Hard sand/rocky sediment environments typically are indicative of higher near-bottom energy regimes, and thus erosional sedimentary environments. Therefore the West Island Ledge site is believed to lie within an erosional area. Other areas off-shore are known to contain sandier sediments ranging from hard fine to medium sand and unconsolidated fine sand habitats.

#### 4.8.3.3 Biological Factors

The biological characteristics of the candidate disposal sites are evaluated below. Various biological factors such as fisheries, benthos, and avifauna were examined independently, however, this analysis attempts to evaluate the *overall* ecosystem in and near each candidate disposal site. A variety of primary and secondary information sources were used. Information that was found to be pertinent to the differentiation of candidate disposal sites is featured in the screening analysis, while other information that is less valuable in this aquatic disposal screening application (but serves to characterize the resource on a large scale) is presented in Appendix E and F.

##### *Benthic Invertebrate Community*

No benthic invertebrate sampling was conducted to determine specific parameters (e.g., species richness, abundance, evenness, diversity, dominance, etc.) of the benthic invertebrate communities within New Bedford/Fairhaven Harbor. Sediment profile images were recorded at the candidate disposal sites to assess the overall health of the bottom (SAIC, 1999a), see Figures 4-27a and 4-27b. Sediment profile imaging is a benthic sampling technique in which a specialized camera is used to obtain undisturbed, vertical cross-section photographs (i.e. *in situ* profiles) of the upper 15 to 20 cm of the sea floor. This is a reconnaissance survey technique used for rapid collection, interpretation and mapping of data on physical and biological sea floor characteristics. Measurements obtained from sediment-profile images can be used to characterize sediment types, evaluate benthic habitat quality, map disturbance gradients, and follow ecosystem recovery after disturbance abatement.

By photographing a cross-section of the upper 20 cm of sediment and overlying water, scientists can: view evidence of benthic invertebrate activity (i.e. worm holes, amphipod tubes); determine oxygenation status of the sediment; estimate the stage of ecological succession on the sea floor; and observe the presence/absence of methane gas which is an indicator of an organically enriched or stressed system.

Results of the New Bedford/Fairhaven Harbor sampling suggest that much of the harbor sediment substrate is inhabited by Stage I successional benthic macroinvertebrate assemblages (SAIC, 1999a). Stage I assemblages usually consist of dense aggregations of near-surface dwelling (pioneering), tube dwelling polychaetes (Rhoads and Germano, 1986). These areas also typically had a shallow RPD depth (Section 4.8.3).

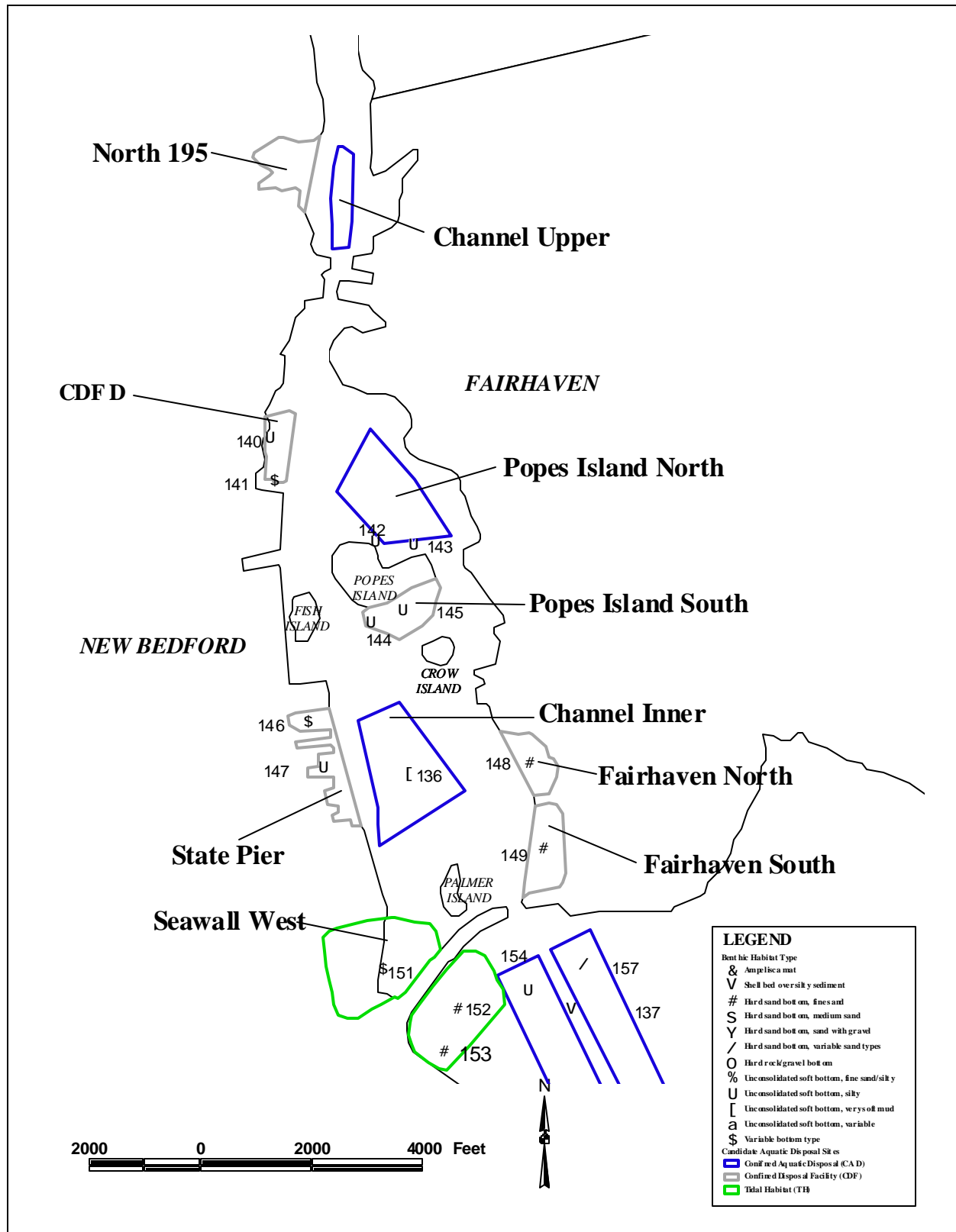


Figure 4-25: Benthic Habitat Type in Upper and Inner New Bedford/Fairhaven Harbor

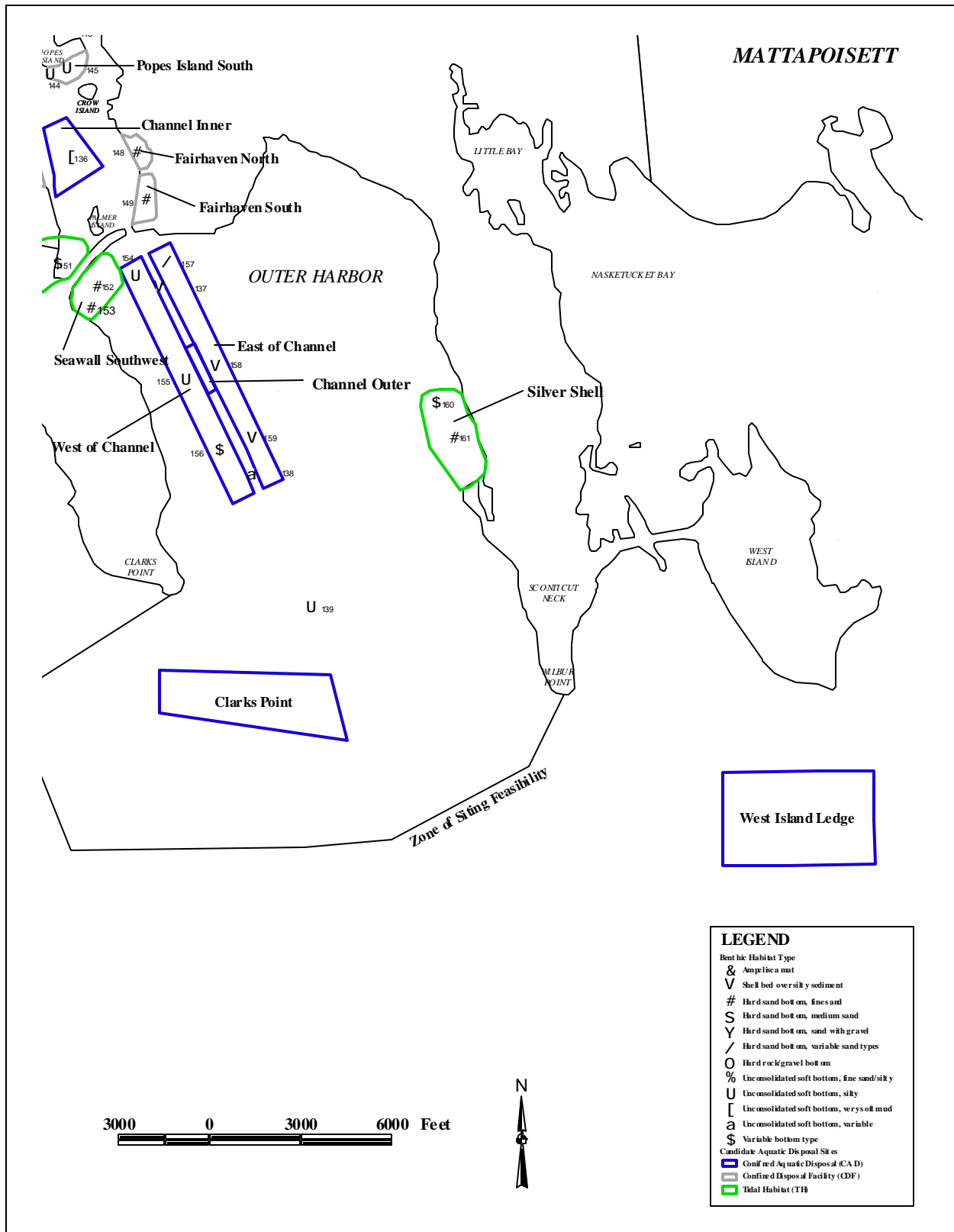
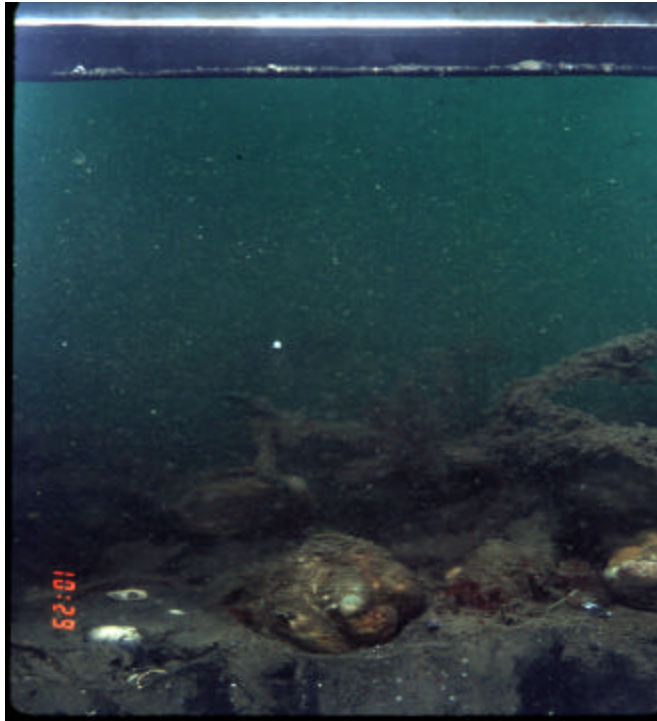
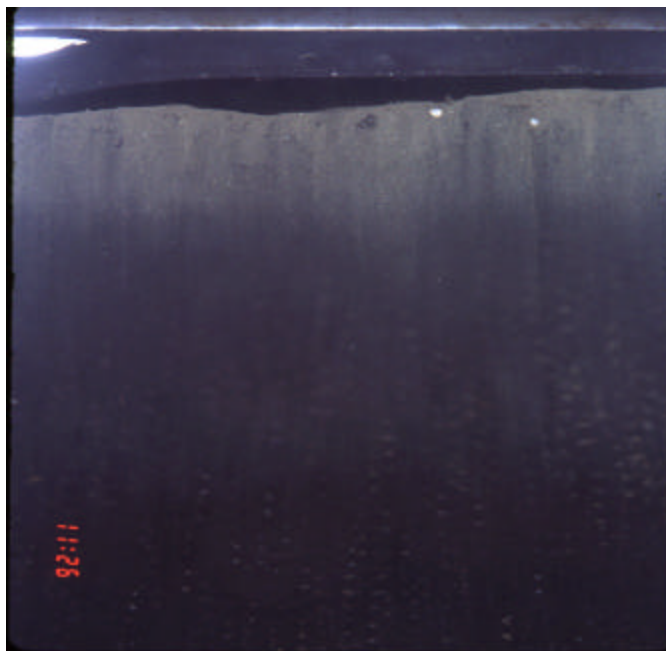


Figure 4-26: Benthic Habitat Types in the Outer Harbor



**Figure 4-27a:** Sediment profile image from station 158, East of Channel site, illustrating shell bed over silt sediment habitat.



**Figure 4-27b.** Sediment profile image from station 136, Channel-Inner site exhibiting unconsolidated soft, silty sediment.

Stage II communities are characterized by mid-successional infaunal deposit feeders such as shallow-dwelling bivalves and tubicolous amphipods (Rhoads and Germano, 1986). No stage II benthic macroinvertebrate assemblages were encountered during sampling throughout the Upper, Lower, and Outer Harbor sediment sampling.

Stage III communities are characterized by the presence of high order (climax) successional infaunal invertebrates including deep burrowing bivalve molluscs. Very few Stage III benthic macroinvertebrate assemblages were encountered during sampling throughout the Upper, Lower, and Outer Harbor sediment sampling. Benthic communities at the New Bedford/Fairhaven Channel, Pope's Island South, and East of Channel sites were found to be characteristic of Stage II communities (SAIC, 1999a).

The Organism-Sediment Index (OSI) is a value which defines overall benthic habitat quality by reflecting the depth of the apparent redox layer, successional stage of infauna, the presence/absence of methane gas in the sediment, and the presence/absence of reduced (i.e., anaerobic) sediment at the sediment-water interface. Therefore, it is a good general summary of benthic habitat quality, which is an important parameter for disposal site selection. OSI values less than 0 indicate degraded habitat quality, values between 0 and +6 reflect intermediate quality (i.e., moderately degraded), and values greater than +6 are considered indicative of good or healthy benthic habitat quality (Rhoads and Germano, 1986).

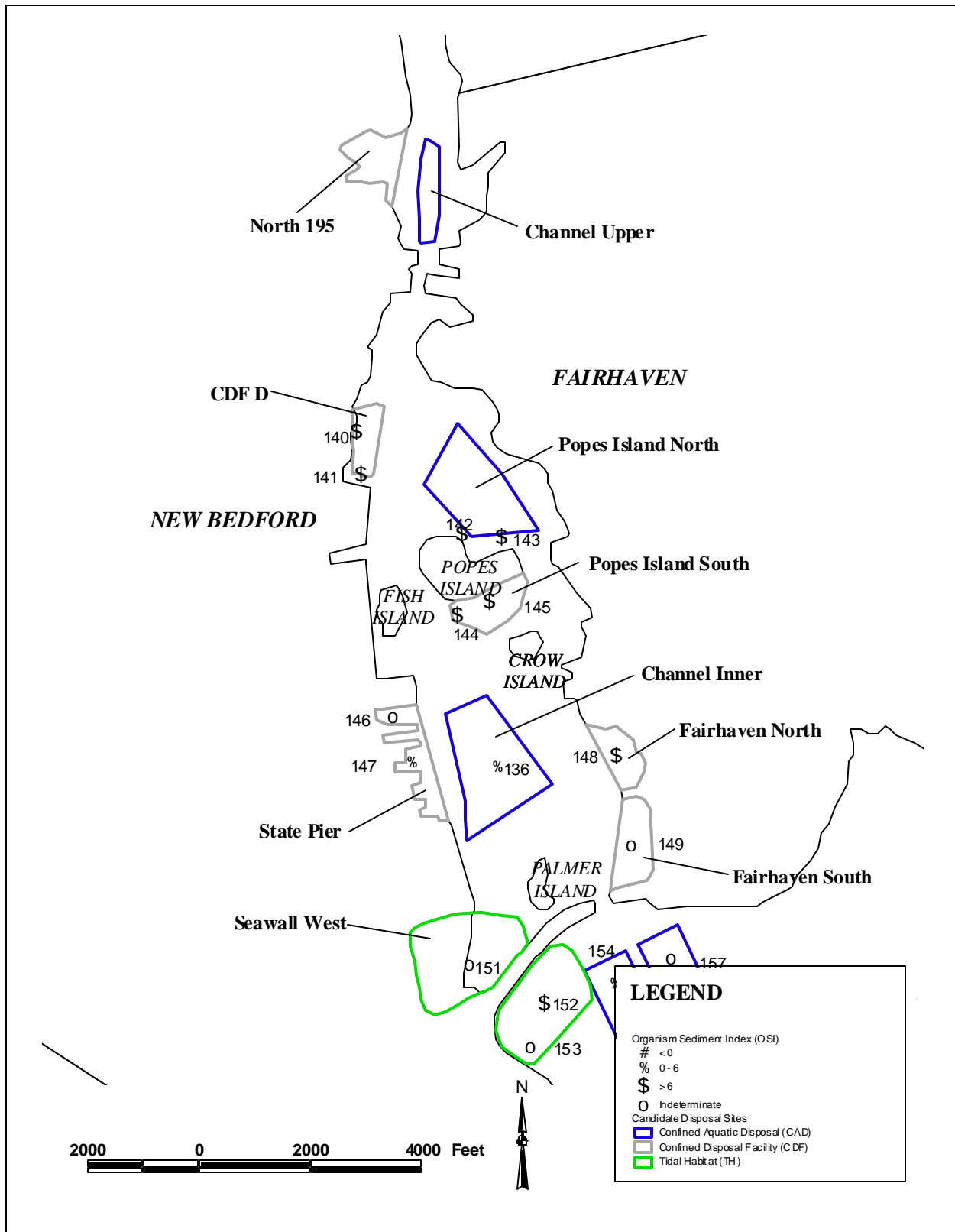
Figures 4-28 and 4-29 show the OSI values for candidate disposal sites in New Bedford/Fairhaven Harbor, and off-shore candidate disposal sites, respectively. In New Bedford/Fairhaven Harbor, no OSI values less than 0 were recorded throughout the aquatic disposal sites. The lowest OSI value recorded (+2) was found within the unconsolidated silty soft bottom sediment of the Railyard CDF. Harbor sites had a range of moderate (0-6) to high (+6) OSI values. OSI values at the New Bedford Channel, Pope's Island South, and East of Channel sites were high. OSI values at many sites could not be surveyed because of insufficient depth for the survey vessel, or other restrictions (e.g. RPD could not be determined) (SAIC, 1999a).

The REMOTS data suggests that habitat quality throughout much of the Upper and Lower Harbor is relatively poor compared to outer harbor and offshore areas. For instance, in the Upper and Lower Harbor areas, the lowest OSI values were recorded in the CDF D and Pope's Island North site. Higher (>6) values are seen in some of the Outer Harbor areas such as the East Channel Station 159 and the Central New Bedford Channel Station No. 138. This finding is consistent with the sediment chemistry results for the harbor. Many contaminant concentrations are highest in the Inner Harbor (Summerhayes, 1985; USEPA, 1996b) and may be either acutely toxic to some invertebrates or may be an additive stress (along with temperature and salinity extremes, that act to limit the upstream distribution of some invertebrates in the Acushnet Estuary.



The high OSI values of the Outer Harbor reflect the widespread presence of Stage III organisms coupled with relatively deep apparent RPD depths at these sites (SAIC, 1999a). At the remainder of the New Bedford/Fairhaven sites (mainly those located in shallower, more protected water closer to shore such as Pope's Island south CDF, the Inner Harbor Channel CAD, and the State Pier CDF sites) OSI values were typically recorded from between +4 to +5. These OSI values are a result of intermediate RPD depths and the predominance of Stage I organisms. The general absence of bioturbating Stage III organisms coupled with possible high inputs of organic matter from runoff and local point sources at the sites within New Bedford/Fairhaven Harbor has resulted in somewhat shallower RPD depths. These factors are, in turn, reflected in the intermediate OSI values which are suggestive of moderately degraded benthic habitat quality. For many REMOTS ® sampling stations, the OSI values were indeterminate. If the RPD depth and/or infaunal successional stage for a particular image are indeterminate, then the OSI value cannot be calculated and is also indeterminate.(SAIC, 1999a).

Infaunal successional stages could not be reliably determined at some sites because the penetration of the camera prism was inhibited by rocks and/or hard sand. Because of this inhibition, no data was collected from REMOTS® Station Nos. 156 (within the west of channel site), 158 (within the east of channel site), 159 and 160 at Silver Shell site; 151 (seawall west), 152 and 153 (Seawall southwest) and 157 (east of channel, north end). At the majority of sites, Stage I was overwhelmingly the dominant successional stage. Stage III was observed in only 4 images out of 43 images taken: REMOTS ® station No. 159 (East of Channel, New Bedford Channel, Central (Station 148) and Pope's Island South).



**Figure 4-28:** OSI Values in Upper and Inner New Bedford/Fairhaven Harbor

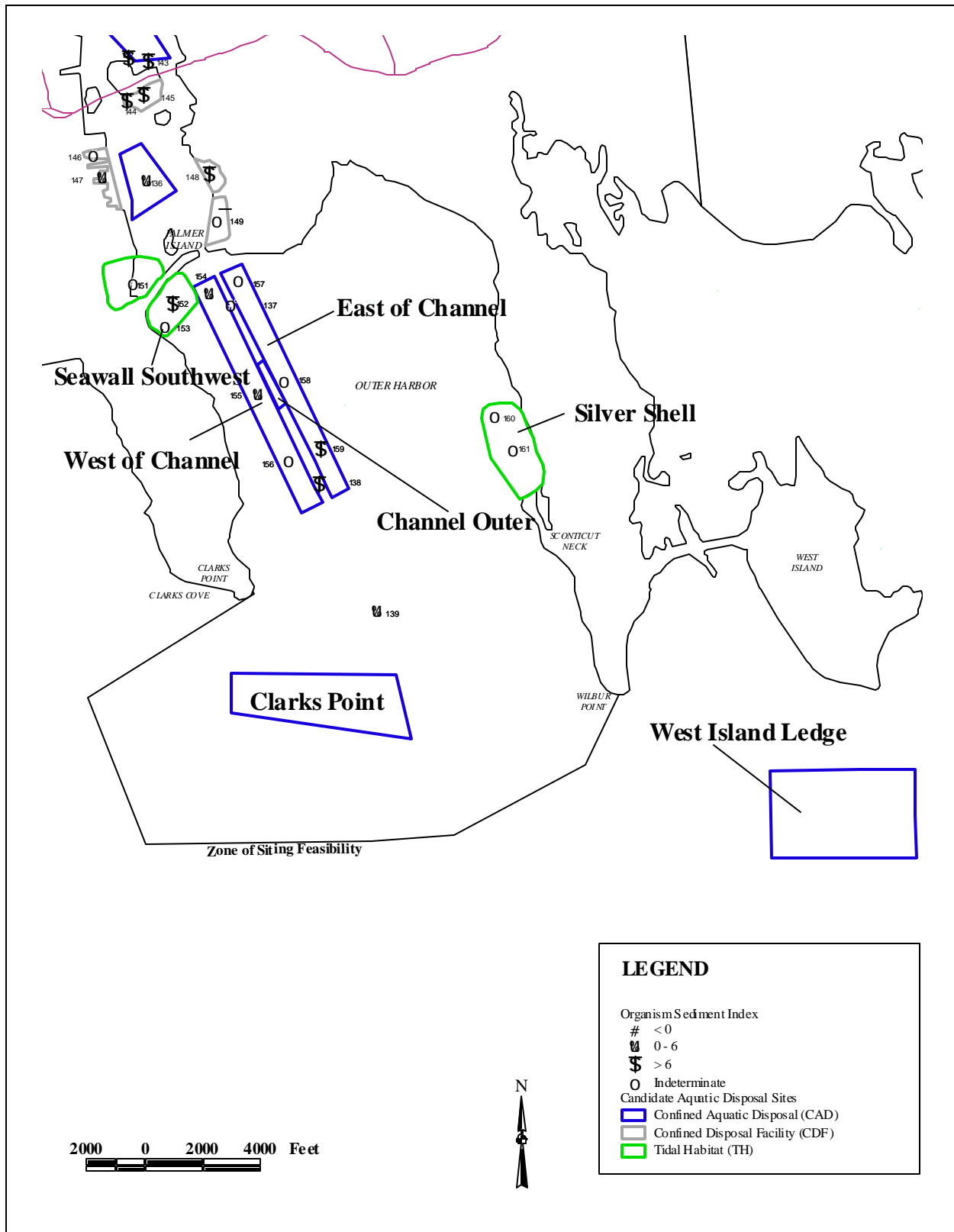


Figure 4-29: OSI Values for Outer Harbor

### *Shellfish*

In Buzzard's Bay the primary shellfish fisheries are quahogs (*Mercenaria mercenaria*), bay scallops (*Aequipecten irradians*), soft-shelled clams (*Mya arenaria*), and oysters (*Crassostrea virginica*) (Figure 4-30). Quahogs are found throughout the harbor and Buzzards Bay and are the dominant shellfish species. All potential disposal sites lie within areas of quahog habitat, either confirmed or probable. Significant patches of the conch/quahog assemblage occur in the Outer Harbor in and near the East of Channel, West of Channel and Clark's Point sites. Portions of Popes Island North lie within both quahog and soft shell clam/oyster/quahog habitat. The quahog fishery is the largest reported fishery in Buzzard's Bay and typically exceeds all other shellfish harvest combined. The scallop industry is reportedly declining - the reason not decisively documented. The oyster industry has also declined over the years in New Bedford/Fairhaven Harbor due primarily to pollution and subsequent bed closures. Areas in New Bedford/Fairhaven Harbor have been seeded by other stock populations and new beds have formed within the harbor on artificial structures. Secondary shellfish fisheries in Buzzard's Bay include surf clams (*Spisula solidissima*) and mussels (*Mytilus edulis*) (Howes and Goehringer, 1996). A continued threat to the shellfish industry in New Bedford/ Fairhaven Harbor and the adjacent regions is contamination by enteric bacteria, as identified through fecal coliform concentrations greater than 14 colonies/100 ml.

In New Bedford/Fairhaven Harbor, quahogs are the major bivalve mollusk shellfish of economic importance. The quahog standing crop was determined by Whittaker (1999) in a recent study. This same study also identified ancillary species of mollusks inhabiting New Bedford/Fairhaven Harbor. The study showed that quahog density varied throughout both the Inner and Outer Harbors and significantly from the Inner Harbor to the Outer Harbor. Whittaker attributed the variances to several factors (e.g. fishing pressure, predation, substrate type, etc). For instance, intense fishing pressure in the Outer Harbor versus lack of fishing in the Inner Harbor was attributed to the variability of the quahog standing crops between the two areas. Other discrepancies were not easily explained by fishing pressure. For instance, among size distribution of the quahog, the large percentage of seed occurred within the Inner Harbor versus the Outer Harbor, despite higher pollutant concentrations in the Inner Harbor. Whittaker suggested the higher concentration of predators in the Outer Harbor may be responsible for low seed levels there. A quahog resources survey conducted in the Outer Harbor by NAI (1999) also found the quahog seed size class to have the lowest standing crop. In the NAI study, standing crop increased with a concurrent increase in size class (i.e. chowder standing crop > cherrystone > littlenecks > seed).

### *Sustainable Annual Quahog Yield*

Whittaker (1999) predicted a continued decline in the quahog densities of "approved areas" within the Outer Harbor if present recruitment rates and market conditions remained the same or similar, and if harvesting continued at it's current rate. The average annual commercial landings currently reported for New Bedford/Fairhaven Harbor are almost equal to the potential harvest. This has caused a diminished catch per unit effort as indicated by Whittaker (1999). Whittaker also identified hydraulic harvesting as a potential impact to quahog settlement and growth due to the negative effects of sediment resuspension, subsequent deposition of silt and redistribution of the predominately mud substrate (Table 4-11).

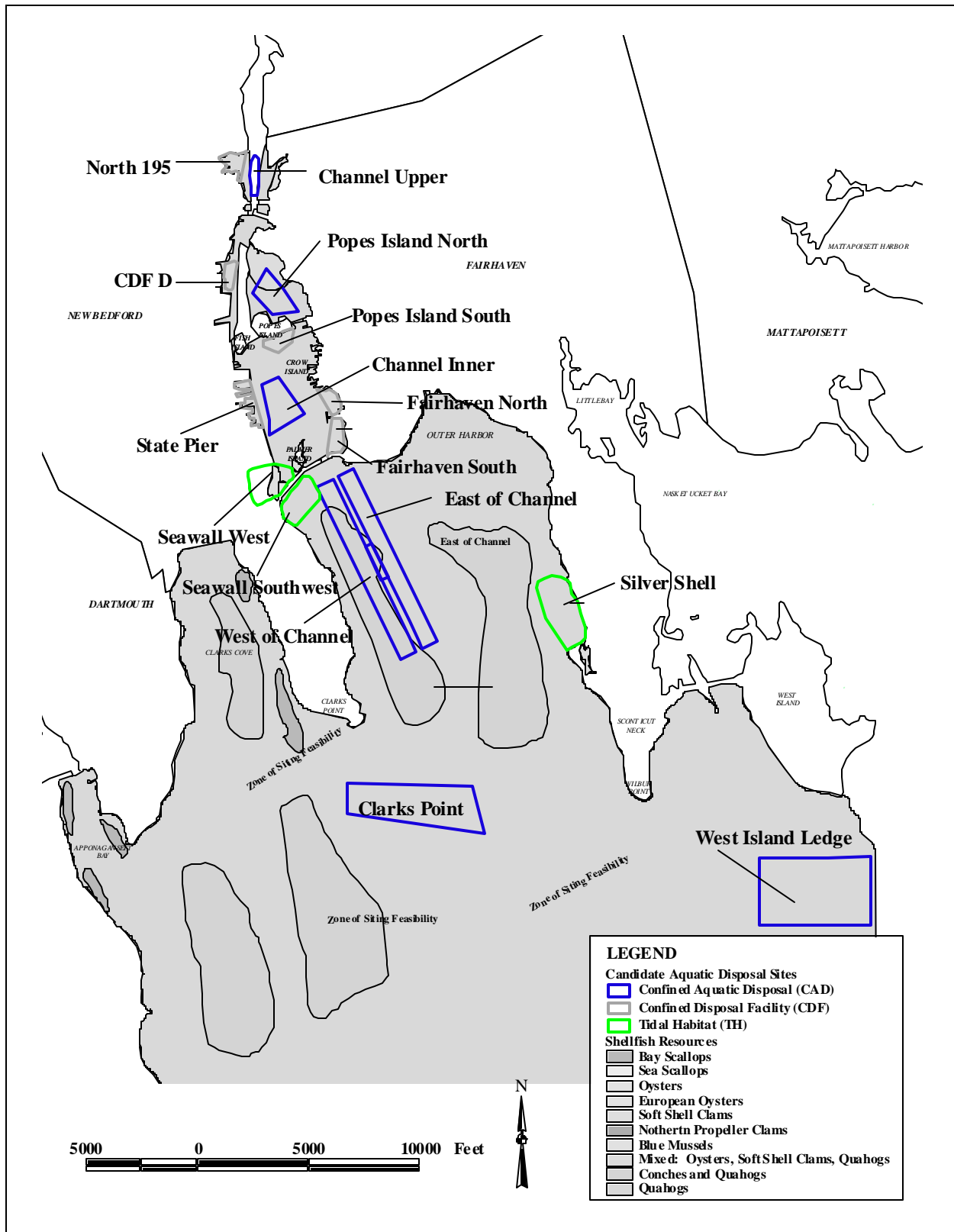


Figure 4-30: Shellfish Resources in the Harbor and Buzzards Bay

**Table 4-11:** Shellfish and Crustacea identified during quahog standing crop survey of New Bedford/Fairhaven Inner and Outer Harbors

Phylum	Class	Common Name	Scientific Name
<i>Mollusca</i>	<i>Gastropoda</i>	Channeled Whelk	<i>Busycon canaliculation</i>
		Knobbed Whelk	<i>Busycon carica</i>
		Oyster Drill	<i>Urosalpinx cinerea</i>
		Moon Snail	Unknown
		Periwinkle	<i>Littorina sp.</i>
		Slipper Shell	<i>Crepidula fornicata</i>
		Cockle	<i>Cyclocardia sp.</i>
	<i>Bivalvia (Pelecypoda)</i>	Quahog	<i>Mercenaria mercenaria</i>
		Soft-shell Clam	<i>Mya arenaria</i>
		Eastern Oyster	<i>Crassostrea virginica</i>
		Bay Scallop	<i>Argopecten irradians</i>
		Razor Clam	<i>Ensis directus</i>
		Ribbed Mussel	<i>Mytilus edulis</i>
		Ark	<i>Anadara sp.</i>
		Jingle	<i>Anomia simplex</i>
		Pitar	<i>Pitar morrhuanus</i>
<i>Arthropoda</i>	<i>Crustacea</i>	Barnacle	<i>Balanoides balanoides</i>
		Mantis Shrimp	<i>Squilla empusa</i>
		Blue Crab	<i>Callinectes sapidus</i>
		Mud Crab	<i>Neopanope rexana</i>
		Green Crab	<i>Carcinus maenas</i>
		Spider Crab	<i>Libinia emarginata</i>
		Lady Crab	<i>Ovalipes ocellatus</i>
		Hermit Crab	<i>Pagurus longicarpus</i>
<i>Echinodermata</i>	<i>Stelleroidea</i>	Common Starfish	<i>Asterias forbesi</i>
<i>Annelida</i>	<i>Polychaeta</i>	Polychaete Worm	<i>Nereis succinea</i>
		Ribbon Worm	<i>Cerebratulus sp.</i>
<i>Porifera</i>		Boring Sponge	<i>Cliona sp.</i>

### *Quahog Relay Potential*

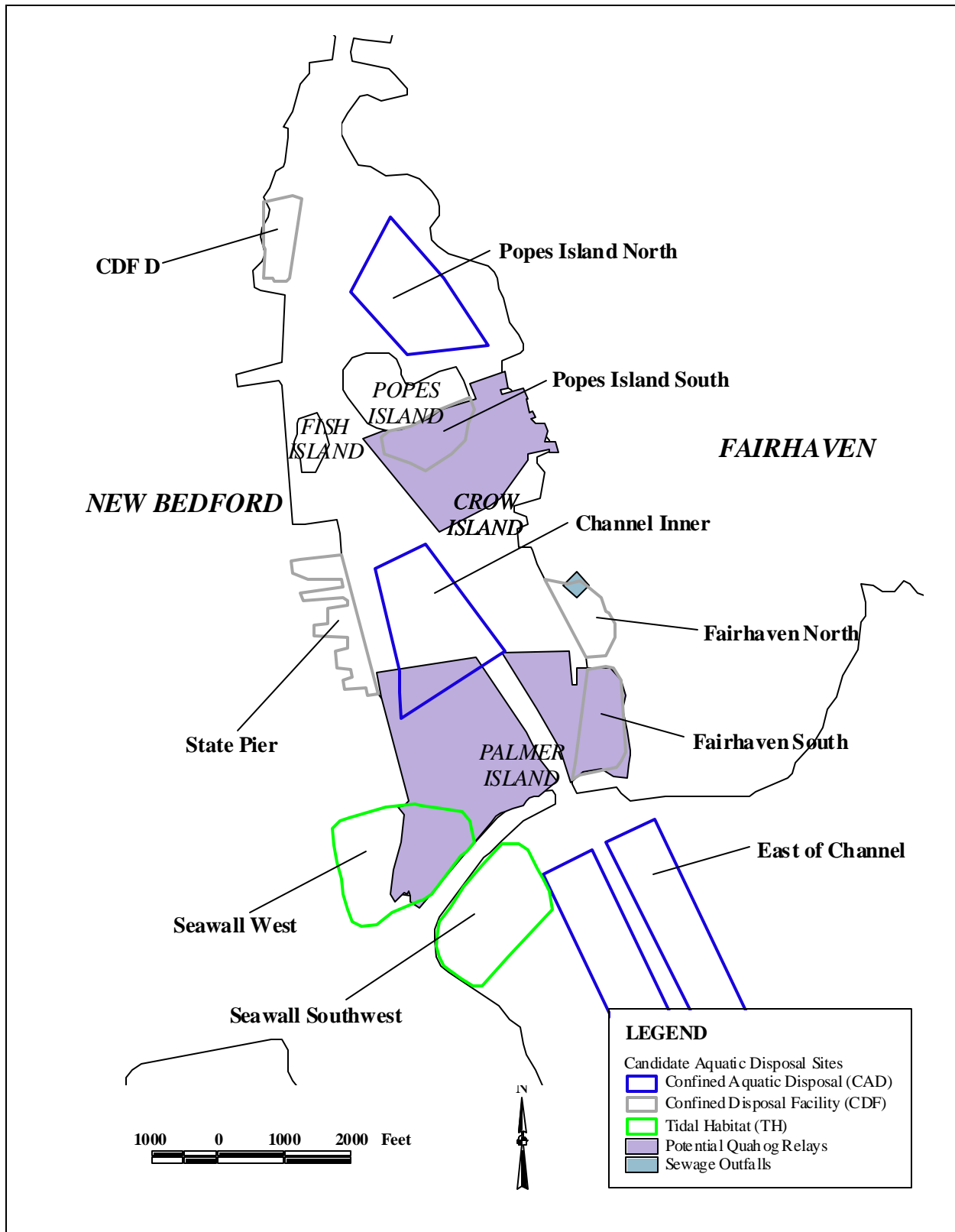
Between the hurricane barrier and the Fairhaven Bridge, the DMF has identified 3 additional areas as having contaminated quahog relay potential (Figure 4-31). They are: an area proximal to Crow Island, the eastern shoreline of Fairhaven between the hurricane barrier and the commercial piers, and Palmer's Cove. Palmer's Cove has been identified by the DMF as the primary area. Full designation of these areas as contaminated quahog relay potential areas is dependent on pending water quality findings of the sanitary survey and quahog tissue analysis.

### *Lobsters*

Lobsters are abundant and the basis of productive fisheries in the New Bedford/Fairhaven Harbor and Buzzards Bay regions. Since lobsters are mobile and are found throughout the region, it is difficult to differentiate among disposal sites on the basis of their potential impact to adult lobsters. Surveys of the marine resources of the New Bedford/Fairhaven Harbor areas, while reporting on the overall importance of the lobster fishery to the area, do not specify which sites or areas are more productive than others. Given the abundance of lobsters throughout the region, dredged material disposal at any one limited site would probably not have a significant effect on the entire existing adult lobster population of the area. However, very young lobsters tend to be more stationary than older juvenile and adults. These lobsters, referred to as early benthic phase (EBP) lobsters, are more susceptible to dredged material disposal activities. Early benthic phase lobster survey data from New Bedford/Fairhaven Harbor was not available for this project.

Because the Inner Harbor is closed to all fishing, including lobstering, sites within the Inner Harbor would be preferred over sites in the Outer Harbor based on this criterion. Outer Harbor sediment is more variable, with areas of sand, gravel and shell litter that are not common in the Inner Harbor. Therefore, lobster habitat is favorable in the Outer Harbor.

On a regional basis, Buzzards Bay is a productive spawning area as evidenced by the percentage of gravid females caught in a 1987 study (31% of catch) when compared to other areas outside of Buzzards Bay: Cape Ann at 4.5%, Salem Sound (Beverly-Salem Area) at 1.8%, Boston Harbor at 1.7%, Cape Cod bay at 3.9% and Outer Cape area at 16.9% (Estrella and McKiernan 1988, 1989). Therefore, Buzzards Bay is an important spawning area and source of lobster larvae for Massachusetts Bay, via the Cape Cod canal (Howes and Goehringer, 1996).

*Finfish***Figure 4-31:** Potential Quahog Relay Areas



Adult finfish can avoid turbidity created by dredging and disposal events and return to a disposal site once operations have ceased and food organisms have returned to the area. However, larval and juvenile fish may not be able to avoid short-term dredge disposal impacts, as well as adults (Blaxter, 1969, 1974; Bannister, et al., 1974; May, 1974; McGurk, 1986; Black et al., 1988; Chambers et al., 1988; Newcombe and Jensen, 1996). Therefore, areas of known concentration of young fish should be avoided.

The following information is summarized below in an effort to characterize and distinguish among sites (or groups of sites) based on the following fisheries information:

- Essential Fish Habitat (EFH) Listings, Buzzards Bay and off-shore areas,
- Diadromous fish activity for New Bedford\Fairhaven Harbor,
- Summary of trawl survey data,
- Areas of commercial and recreational fishing,
- Evaluation of nursery potential by site; and,
- Comparison of spawning potential (offshore versus harbor sites).

### *Essential Fish Habitat*

Under the Magnuson-Stevens Fishery Conservation and Management Act, (a.k.a. the Sustainable Fisheries Act, or SFA), an EFH is broadly defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity”. All of the candidate aquatic disposal sites are located within designated EFH. Therefore, the EFH regulatory criterion is not a discriminating factor in aquatic disposal site selection.

### *Diadromous Fish Activity*

Five of the fish species listed as commercially important or as residents in Buzzards Bay are diadromous species that have been reported from the New Bedford\Fairhaven Harbor ZSF. They are alewife, American shad, blueback herring, rainbow smelt and American eel. Diadromous fish are those that at any particular life stage, regularly move between freshwater and saltwater, spending part of their life cycle in each environment. Diadromy is further divided into three categories to include anadromy, catadromy, and amphidromy. Anadromous fish move from marine waters to inland freshwaters to spawn. Catadromous fish move from freshwater to marine environments to spawn. Amphidromy is a term usually used to describe the movement of immature fish between either environment (Matthews, 1998). Anadromous and catadromous species are discussed below.

### *Anadromous Species*

Four of the diadromous fish species reported from the New Bedford\Fairhaven ZSF, are Anadromous. They are the alewife, American shad, blueback herring, and rainbow smelt. Of the Anadromous fish, only the alewife and possibly the blueback herring have been reported to spawn within the Acushnet River (VHB, 1996). Alewife are known to spawn upriver at Saw Mill Pond (Howes and Goehring, 1996).

Like other fish they migrate through New Bedford/Fairhaven Harbor with the warming of inland waters relative to offshore water. Therefore, migration begins in early March or April, depending on seasonal conditions, and continues into June. Other Anadromous fish runs were formerly present within the Acushnet River but have since been extirpated due to water quality impacts, upstream blockages and other human induced impacts (Howes and Goehring, 1996).

On their spawning grounds, alewife and blueback herring broadcast eggs across the bottom of suitable substrate. Eggs are fertilized by the male broadcasting sperm over the eggs. Like other broadcast spawners, these species tend to have high fecundity. Egg production rates are reported to be between 60,000 and 300,000 eggs per year. An average mature female releases 125,000 to 150,000 eggs in a typical spawning run (Brady, 2000). Therefore, with the re-establishment of favorable conditions along the Acushnet River (e.g. the removal of dams and other barriers to fish passage, and water quality improvements) productive and successful fish runs could be restored to this drainage. Natural increases in Anadromous fish runs have been reported for other rivers in the south coastal drainage systems (Brady, 2000).

#### *Catadromous Species*

The American eel is the only catadromous fish species native to the Acushnet River drainage that passes through New Bedford/Fairhaven Harbor in destination to its breeding grounds, the Sargasso Sea (Howes and Goehring, 1996).

#### *Summary of Finfish Sampling Studies*

Numerous finfish sampling programs have been conducted in New Bedford/Fairhaven Harbor over the years by the DMF, and others employing both seine and trawling techniques. Table 4-12 summarizes the results of various sampling programs or surveys from 1972 to 1999. Due to the variation in sampling frequency, methods, location, and seasonality, no quantitative statistical comparisons could be made among all the various finfish surveys conducted to date. However, they do serve to characterize the ichthyofaunal composition within the harbor areas.

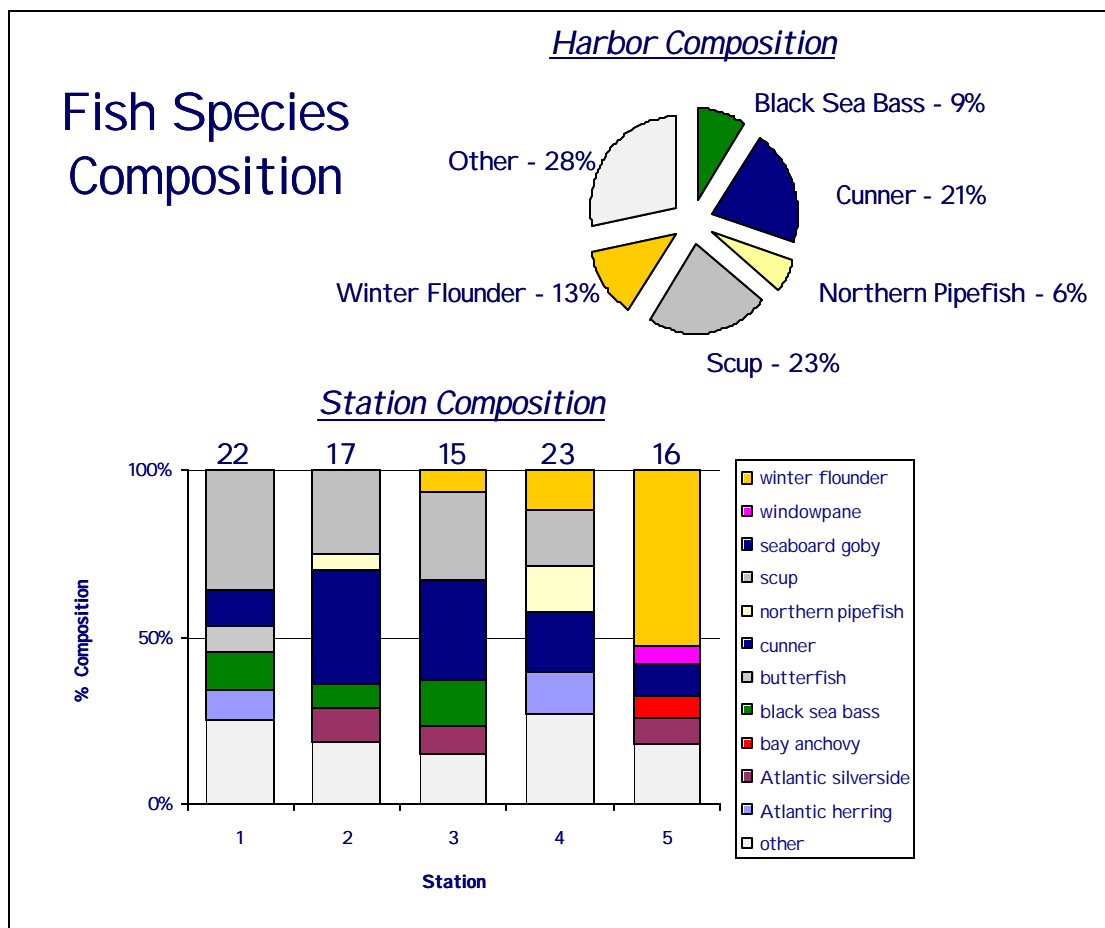
Most specific to the New Bedford/Fairhaven DMMP was a finfish sampling survey conducted by Normandeau in 1999. Five trawl and three beach seine samples were taken monthly in 1998 and 1999 at locations in and near some of the potential disposal sites (Figure 4-33). Three of the trawl stations were in the outer harbor (NT-1, NT-2 and NT-3) and two stations (NT-4 and NT-5) were in the inner harbor. Data from this study can be used to generally characterize the inner and outer harbor fish composition. However, due to the transitory nature of fish and the limited number of samples taken over a relatively short period of time, comparison of fish habitat relative to the potential disposal sites would be conjectural. The 1999 Normandeau study, combined with the other studies in Table 4-12 serve to characterize the type of fish that commonly occur in the inner and outer harbor areas.

**Table 4-12:** Summary of Finfish Sampling Conducted in New Bedford/Fairhaven Harbor, 1972-1990

Sample Date	Location as Reported	Sampling Methods	Target Sampling Subjects	Source	Results Summary
Feb - May, 1972	Within and between Acushnet River and Westport River estuaries	Net tows	Ichthyoplankton	Giovani, 1973	Larvae of nine taxa sampled: including sand lance, sculpin, winter flounder, Atlantic herring, Atlantic cod, pollack, tomcod, snakebelly gunnel, sea snail, rock gunnel, and four beard rockling
December, 1972 April 1973 December 1973	Lower and Inner Harbor	Trawls	Water column and demersal ichthyofauna	Hoff et al., 1973	Windowpane and winter flounder most abundant species sampled in December (higher catches in the Inner harbor). Eight species collected during sampling
December 1972	Outer Harbor	Trawls	Water column and demersal ichthyofauna	Hoff et al., 1973	Window pane and winter flounder most abundant species sampled in December. Six species collected during sampling
1976-1979	Eastern Buzzards Bay	Net tows	Eggs, larvae, and juveniles	DMF (Collins et al., 1981)	Peak egg densities found during summer; highest egg densities from Atlantic menhaden, scup, weakfish, cunner and yellowtail flounder. Larval densities peaked in June; highest densities being cunner and tautog
Summer 1987	Shallow water areas proximal to salt marshes within the harbor	Seine and bait trapping techniques	Water column finfish	Bellmer, 1988	Sixteen fish species captured; Atlantic silversides and two species of mummichog were the most abundant. Study also included analysis of stomach contents of mummichog and winter flounder

**Table 4-12:** Summary of Finfish Sampling Conducted in New Bedford/Fairhaven Harbor, 1972-1990 (continued)

Sample Date	Location as Reported	Sampling Methods	Target Sampling Subjects	Source	Results Summary
1990	New Bedford / Fairhaven Harbor: Upper, Inner and Outer Harbors		Winter Flounder	Battelle Memorial Institute	Age I and II winter flounder found year round throughout Acushnet River Estuary including Inner Harbor, and Outer Harbors and Upper Buzzards Bay suggesting spawning on shoals of these areas. Larger (age IV and V) flounder found in Outer Harbor and Upper Buzzard's Bay.
1990	New Bedford / Fairhaven Harbor: Upper, Inner and Outer Harbors		Ichthyofauna	EBASCO, 1990	Eight fish species identified as representative of five habitat zones within the Estuary and Harbor
1999	New Bedford / Fairhaven Inner and Outer Harbors	Trawls, beach seines	Ichthyofauna	Normandeau, 1999	Five species dominant deep water, silversides dominate shallows.



**Figure 4-32:** Fish Species Composition at 5 Trawl Stations in 1998/1999 (from Normandeau, 1999)

As shown in Figure 4-32, cunner, winter flounder, scup, black sea bass and northern pipefish were the dominant fish caught at the 1998-1999 trawl stations. Generally, cunner accounted for a higher percentage of fish species caught in the outer harbor versus the inner harbor. The highest relative abundance of winter flounder was caught at NT-5, near the Popes Island North potential disposal sites. However, overall catch-per-unit effort (CPUE) was lowest at this station. In general, the highest CPUE was recorded at the outer harbor stations.

In the beach seine samples, the Atlantic silverside was the most abundant fish, caught at all three stations. Striped killifish, cunner, mummichog, Atlantic menhaden, and winter flounder were also abundant at most stations.

The most abundant offshore (i.e. outside New Bedford/Fairhaven Harbor but within Buzzards Bay) finfish are scup, winter flounder, and butterfish. Bluefish, striped bass and Atlantic mackerel are reported as abundant on a seasonal basis using the bay in the summer and fall as nursery habitat (Howes and Goehring, 1996).

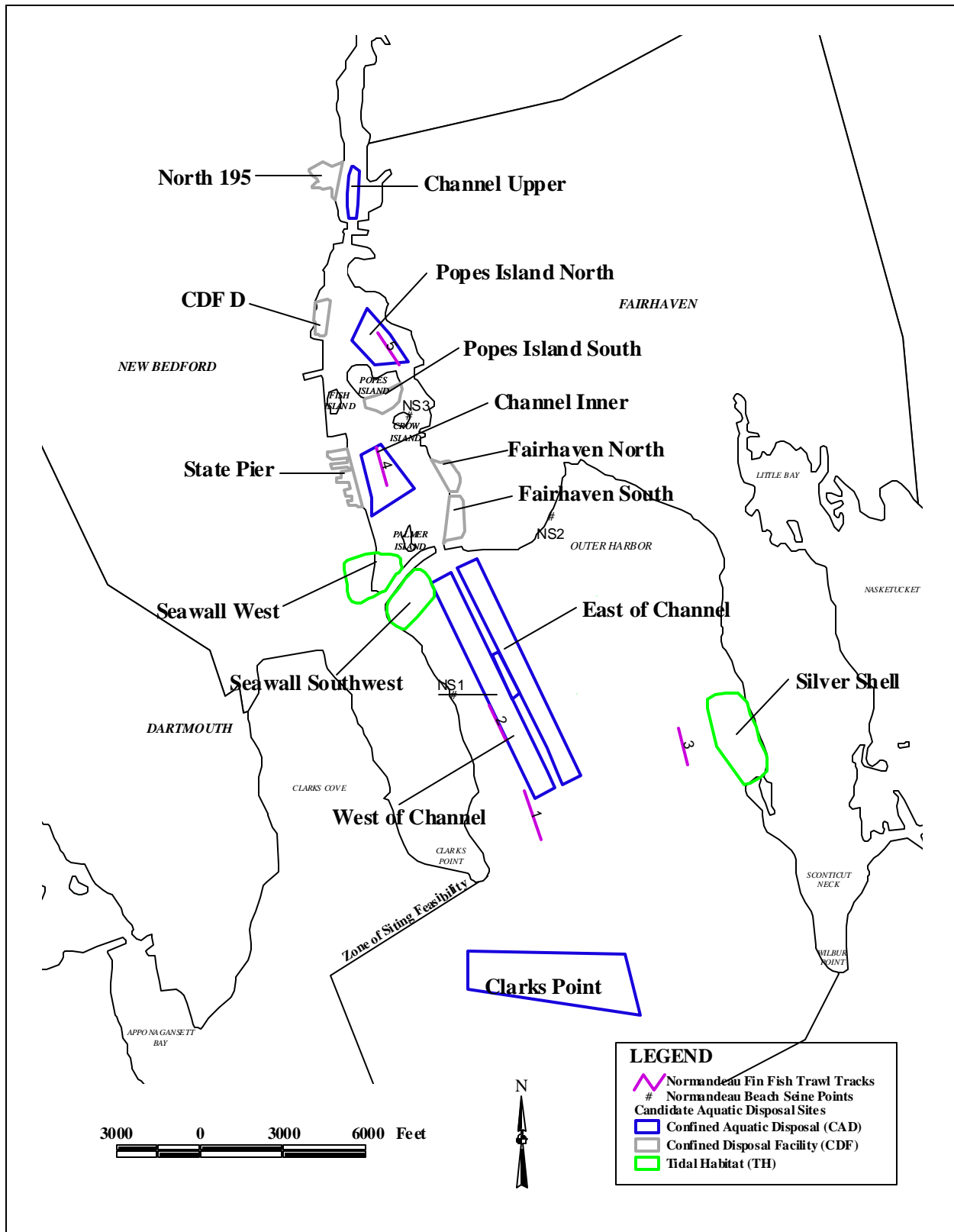


Figure 4-33: Beach Seine and Trawl Locations

Historically, shad, alewife, and blueback herring were of great economic importance for food and fertilizer within the watershed of Buzzards Bay. These species were typically reported as the dominant fish in Buzzards Bay from pre-1920's data sets (Howes and Goehringer, 1996). Today, the dominant fisheries in Buzzards Bay are centered around shellfishing (see previous subsection). However, ten fish species are reported to be of economic importance.

#### *Evaluation of Finfish Nursery Potential by Site*

Utilizing the information from the various available finfish surveys, as well as knowledge of the benthic habitat types within the harbor areas, and other literature, the potential for each candidate site as a nursery for finfish and large invertebrates was assessed. Dredged material disposal is more likely to affect sensitive larval and juvenile stages of fish and invertebrates, so the protection of areas with high nursery potential is an important element of the screening analysis.

Table 4-13 summarizes the nursery potential of each site. Nursery potential is estimated using the following empirical formula from Wilbur (1999):

$$\text{HABITAT COMPLEXITY} + \text{JUVENILE PRESENCE} = \text{NURSERY POTENTIAL (HIGH, MODERATE, LOW)}$$

Habitat complexity, rated on a scale of 1-12, is highest where there is variation in substrate conditions. Juvenile presence (yes/no) is the dominant commercial, recreational and non-target organism collected in substantial numbers or apparent in similar habitat.

As shown in Table 4-13, the Channel and Silver Shell sites have high nursery potential. No data was available for off-shore sites (West Island Ledge and Clark's Point). The high nursery potential at the Silver Shell site is a function of high benthic habitat complexity, presence of fine sand substrate and presence of SAV. Mummichog, cunner, and winter flounder are the dominant juvenile species present at the upper and lower Harbor sites. In addition to these species, black sea bass and scup are common juveniles at the Outer Harbor sites and off-shore at Clark's Point. No data was available for the West Island Ledge site.

Submerged aquatic vegetation was present at the Silver Shell site. This site also had the highest benthic habitat complexity, and relatively better water quality in comparison to the Upper Harbor sites. These two factors combined, resulted in a high rating for finfish nursery potential. Sites in and adjacent to the channel within the Outer Harbor also have high potential as nurseries because of relatively high substrate complexity and relatively large catches of juvenile fishes.

Upper harbor sites consistently had the lowest potential as nurseries because of relatively low substrate complexity, no submerged SAV, poor water quality and relatively lower catches of demersal fishes.

No SAV beds were found within any of the Lower Harbor sites. Here, the substrate varies in complexity. Water quality at these sites was measurably better than the Upper Harbor sites but not as good as the Outer Harbor. Therefore, the Lower Harbor sites generally represented a transition (low to moderate) area for finfish nursery potential.

**Table 4-13.** Relative Nursery Values and Dominant Juvenile Fishes and Lobster for Candidate Disposal Sites

Disposal Site	Benthic Habitat Complexity	Juvenile Presence (ssp. collected with highest abundance)	Nursery Potential
<b>UPPER HARBOR SITES</b>			
North 195	NA	mummichog, cunner, winter flounder	N/A
Upper Channel	10	scup, black sea bass, cunner, winter flounder	Moderate-High
<b>INNER HARBOR SITES</b>			
CDF D	3	mummichog, cunner, winter flounder	Low-Moderate
Popes Island North	1	mummichog, cunner, winter flounder	Low-Moderate
Popes Island South	3	mummichog, cunner, winter flounder	Low-Moderate
Channel Inner	10	scup, black sea bass, cunner, winter flounder, northern pipefish	Moderate-High
State Pier	10	mummichog, cunner, winter flounder	Moderate
Fairhaven North	1	mummichog, cunner, winter flounder	Low-Moderate
Fairhaven South	4	mummichog, cunner, winter flounder	Moderate
Seawall West	5	mummichog, cunner, winter flounder	Moderate
<b>OUTER HARBOR SITES</b>			
Seawall Southwest	5	mummichog, cunner, winter flounder	Moderate
West of Channel	10	scup, black sea bass, cunner, winter flounder	High
East of Channel	10	scup, black sea bass, cunner, winter flounder	High
Channel Outer	10	scup, black sea bass, cunner, winter flounder	Moderate-High
Silver Shell	12	mummichog, cunner, winter flounder	High
<b>BUZZARDS BAY SITES</b>			
West Island Ledge	N/A	no data available	N/A
Clark's Point	N/A	scup, black sea bass, cunner, winter flounder	N/A

*American lobster based on the presence of hard bottom (i.e. gravel/cobble)*



*Comparison of Finfish Spawning Potential in Off-shore versus Harbor Sites*

Spawning is an essential life history activity of all marine and estuarine organisms. Specific habitat conditions are required to induce spawning and support successful reproduction and development. Spawning occurs over a wide range of substrates depending on the species. These substrates include, but are not limited to, silty sand, sand, gravel, cobble, boulder, shellbeds, eelgrass, etc. Spawning periods and conditions for the most common fish and invertebrates are widely known and many local surveys have identified important habitat associations that appear to be essential to induce spawning and for the reproduction and development of fishes and invertebrates after spawning.

Based on habitat associations and regional distribution of spawning activity, several demersal finfish species may locate suitable environmental conditions for spawning within Massachusetts ports, estuaries and/or open water (Wilbur, 2000). Some fish species can spawn in both coastal and off-shore waters (i.e. winter flounder), while many species prefer only one of the two regions (Table 4-14).

**Table 4-14:** Summary of Distribution of Selected Fish Spawning Activity in New Bedford/ Fairhaven Harbor (Harbor Sites), and Buzzards Bay (Off-Shore Sites)

Common Name	Harbor Sites	Off-Shore Sites
Atlantic silversides ( <i>Menidia menidia</i> )	X	
Striped killifish ( <i>Fundulus majalis</i> )	X	
Atlantic Herring ( <i>Clupea harengus</i> )		X
Cunner ( <i>Tautoglabrous adspersus</i> )	X	
Black Sea Bass ( <i>Centropristis striata</i> )		X
Mummichog ( <i>Fundulus heteroclitus</i> )	X	
Northern pipefish ( <i>Syngnathus fuscus</i> )	X	
Ocean pout ( <i>Macroarces americanus</i> )	X	
Scup or "Porgy" ( <i>Stenotomus chrysops</i> )		X
Winter flounder ( <i>Pseudopleuronectes americanus</i> )	X	X
Atlantic Cod ( <i>Gadus morhua</i> )		X
Haddock ( <i>Melanogrammus aeglefinus</i> )		X
Windowpane Flounder ( <i>Sopthalmus aquosus</i> )		X
Summer Flounder ( <i>Paralichthys dentatus</i> )		X
Atlantic Butterfish ( <i>Peprilus triacanthus</i> )	X	X
Atlantic Mackerel ( <i>Scomber scombrus</i> )	X	

Whether a potential disposal site would lie in nearshore versus offshore waters is not necessarily a strong discriminating factor in disposal site selection and resultant impact to fish spawning because both off-shore and coastal water habitats support fish spawning. Of greater significance is the seasonality of spawning for the dominant fish and invertebrates. Dredging and disposal restrictions are imposed on Massachusetts harbors by MADEP to protect the spawning activities of the dominant species within certain regions of Massachusetts coastal waters. Table 4-15 lists the dominant fish and invertebrate species and their known spawning seasons in the Buzzard's Bay region including the Bay's harbors. As indicated in Table 4-15, spawning for most organisms occurs in the spring, summer and early fall. As such, dredging has historically been limited to the late fall and winter season to protect spawning activities of many species. The imposition of seasonal restrictions avoids impacts to sensitive eggs and larvae in the water column (pelagic) and on the sea floor (demersal).

**Table 4-15:** Spawning Seasons for Common Nearshore Invertebrate and Fish Species of Buzzards Bay, including New Bedford/Fairhaven Harbor

Common Name	Spawning Season
<b><i>Invertebrates</i></b>	
American lobster ( <i>Homarus americanus</i> )	April - May <sup>1</sup>
Atlantic rock crab ( <i>Cancer irroratus</i> )	July - October <sup>1</sup>
Green crab ( <i>Carcinus maenas</i> )	June - October <sup>1</sup>
Blue mussel ( <i>Mytilus edulis</i> )	April - October <sup>1</sup>
Softshell clam ( <i>Mya arenaria</i> )	March - July <sup>1</sup>
Northern quahog ( <i>Mercenaria mercenaria</i> )	June - August <sup>1</sup>
Green sea urchin ( <i>Strongylocentrotus droebachiensis</i> )	February - April <sup>1</sup>
<b><i>Finfish</i></b>	
Winter flounder ( <i>Pseudopleuronectes americanus</i> )	February - June <sup>1</sup>
Windowpane flounder ( <i>Scopthalmus aquosus</i> )	Feb - Nov (Peaks in May and Oct) <sup>2</sup>
Black sea bass ( <i>Centropristis striata</i> )	May - October <sup>2</sup>
Scup ( <i>Stenotomus chrysops</i> )	May - August <sup>2</sup>
Butterfish ( <i>Peprilus triacanthus</i> )	spring and summer <sup>2</sup>
Rainbow smelt ( <i>Osmerus mordax</i> )	March - May <sup>1</sup>
Striped bass ( <i>Morone saxatilis</i> )	June - July <sup>1</sup>
Alewife ( <i>Alosa pseudoharengus</i> )	April - May <sup>1</sup>
Blueback herring ( <i>Alosa aestivalis</i> )	April - July <sup>1</sup>

Source: <sup>1</sup> Howes and Goerhinger, 1996

<sup>2</sup> NMFS/NERO, [www.nero.nmfs.gov/ro/doc/efhtables.pdf](http://www.nero.nmfs.gov/ro/doc/efhtables.pdf)

However, there is overlap among the various fish species in their spawning seasons. Therefore, potential impact to all fish spawning activity may not be avoided through seasonal restrictions alone. Within the season, spawning can be spatially variable in the Buzzards Bay and Massachusetts coastal waters due to presence or absence of specific habitat requirements that are required for spawning (e.g., temperature, salinity, depth, substrate, etc.). Spawning potential can be better predicted in a given location based on presence or absence of these special spawning habitat requirements. Table 4-16 lists the special habitat requirements for spawning of managed fish species known to occur within New Bedford/Fairhaven Harbor and adjacent Buzzard's Bay waters.

**Table 4-16:** Spawning Requirements for some Common Managed Inshore Fish and Invertebrate Species known to Spawn in New Bedford/Fairhaven Harbor and Adjacent Waters of Buzzards Bay

Species Name	Temp. (°C)	Salinity (‰)	Depth (m)	Substrate
Atlantic cod ( <i>Gadus morhua</i> )	<12	10 - 35	<110	surface waters
Haddock ( <i>Melanogrammus aeglefinus</i> )	<10	34 - 35	50 - 90	surface waters
Winter flounder ( <i>Pleuronectes americanus</i> )	<10	10 - 32	0.3 - 4.5 (inshore)	sand, muddy sand, mud, gravel
Windowpane flounder ( <i>Sopthalmus aquosus</i> )	<20	n/a	<70	surface waters
Atlantic butterfish ( <i>Peprilus triacanthus</i> )	11 - 17	25 - 33	0 - 1829	pelagic waters
Atlantic mackerel ( <i>Scomber scombrus</i> )	5 - 23	18 - >30 (peak >30)	0 - 15	pelagic waters
Summer flounder ( <i>Paralichthys dentatus</i> )	n/a	n/a	fall: 30 - 70; winter: 110; spring: 9 - 30	pelagic waters
Scup ( <i>Stenotomus chrysops</i> )	13 - 23	13 - 23	<30	pelagic waters in estuaries
Black sea bass ( <i>Centropristis striata</i> )	n/a	n/a	0 - 200	upper water column

Source: NMFS/NERO, [www.nero.nmfs.gov/ro/doc/efhtables.pdf](http://www.nero.nmfs.gov/ro/doc/efhtables.pdf)

### *Coastal Wetlands and Submerged Habitats*

Generally speaking, coastal wetlands include areas of submerged aquatic vegetation, salt ponds, salt marsh and tidal flats, and are subject to daily tidal action. Activities within or near these resources are regulated under the Massachusetts Wetlands Protection Act and Section 404 of the Clean Water Act. Coastal wetlands are productive habitat for wildlife, finfish and shellfish, and therefore, should be avoided to ensure protection. Disposal sites within or adjacent to these resources should be avoided.

### *Submerged Aquatic Vegetation Beds*

SAV beds, which are found in shallow, clear waters, are extremely important habitats for fish and invertebrates. They are used as nurseries for various marine life, especially juvenile finfish, such as sticklebacks. SAV beds also filter pollutants and sediment from the water column and stabilize sediments in potentially erosive or reworking zones.

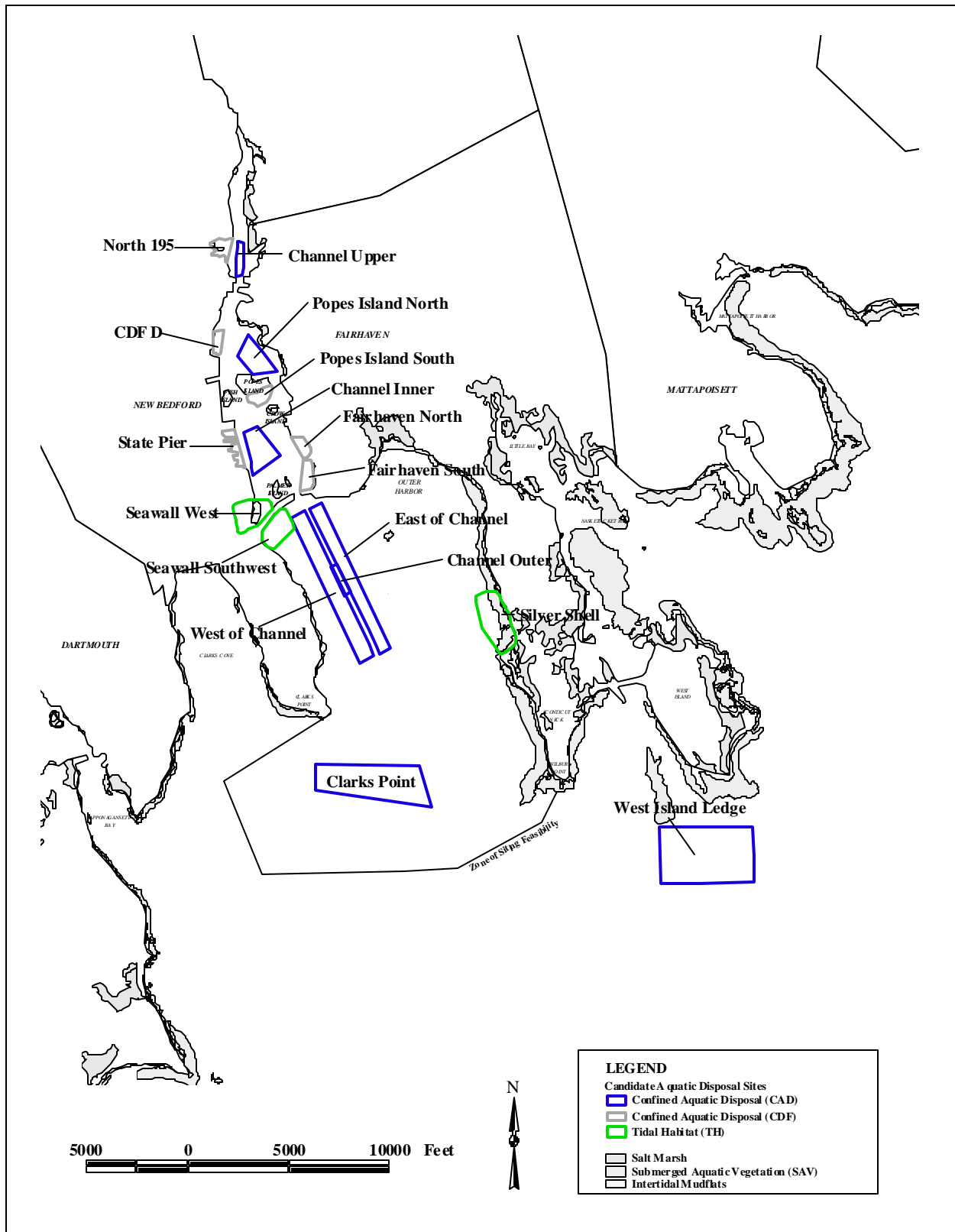
In the northeast, eelgrass is the primary SAV. Eelgrass is the preferred winter food of Brant (*Branta bernicula*), a marine goose. Eelgrass beds also provide habitat for a variety of marine organisms such as epiphytic algae and bryozoans, shellfish (e.g. bay scallops), shrimp and other invertebrates both sessile or motile (Gosner, 1978).

Direct impact, i.e. loss of the resource, would occur if a disposal site were located within the resource area, however indirect impacts from the suspended sediment plume, created by disposal or excavation of a CAD pit, can occur if the resource is nearby and down-drift of the disposal area. Based on previous studies in similar marine environments, the area of impact from disposal is estimated at approximately 300 feet from the disposal activity (see Section 6 for details), therefore disposal sites that are located at least 300 feet from a coastal wetland or SAV beds are more desirable.

Eelgrass beds were identified from aerial photographs of the New Bedford/Fairhaven area, and from other literature sources (Howes and Goehring, 1996; Costello, 1997; NOAA/MACZM, 1998). The major eelgrass areas occur on the eastern shore of Fairhaven Harbor, just north of the hurricane barrier in the Lower Harbor and in the subtidal areas around Popes Island. The known stands of eelgrass around Popes Island are proximal to the Popes Island North, Popes Island North 2; Popes Island North 3 and Popes Island South candidate aquatic disposal sites. Figure 4-34 depicts the known eelgrass resources in the New Bedford/Fairhaven harbor areas.

Costa (1988) found stands of eelgrass beds at water depths between 0.9-3.0 m below mean low water. Therefore, this submerged aquatic vegetation is characteristic of shallow, nearshore areas, and would not be expected to be found in or proximal to the candidate offshore aquatic disposal sites.

*Intertidal Flats*



**Figure 4-34:** Submerged Aquatic Vegetation, Intertidal Areas and Candidate Sites

The most extensive intertidal flats exist in the southeast corner of the Lower Harbor just north of the seawall, on the northern end of the Outer Harbor in Priests Cove, and on the eastern side of the Outer Harbor south of Silver Shell beach (Figure 4-34).

#### *Salt Marsh*

No extensive salt marshes exist along the open coastlines of Clark's Point on the western side of the Outer Harbor in New Bedford. However, significant expanses of salt marsh lie on the eastern side of the Outer Harbor in Fairhaven, specifically, on the north end of the Outer Harbor in Priests Cove and on the east side of the Outer Harbor, south of Silver Shell Beach. Elsewhere, salt marsh lies within the Upper Harbor just south of the Interstate 195 bridge (Figure 4-34).

#### *Herpetofauna*

Reptiles found in the study area include sea turtles and the terrestrial semi-aquatic diamond-back terrapin (*Malaclemys t. terrapin*). Sea turtles, which do not breed in or near Massachusetts, are oceanic animals, feeding on jellyfish and are present mainly in summer (See Section 5.3.5.3). They are not dependent on the bottom and would not be affected by any localized change in bottom conditions. Turtles are sparse in distribution and could readily avoid any local, temporary changes in water conditions brought about by disposal operations. Although sea turtles are more likely to be found near one of the open ocean sites rather than within New Bedford/Fairhaven Harbor, their presence should not be a determining factor in site selection. Federally listed species that have been recorded in Buzzards Bay waters are: the threatened loggerhead (*Caretta caretta*), the endangered Kemp's Ridley (*Lepidochelys kempii*) and the endangered leatherback (*Dermochelys coriacea*).

The diamond-back terrapin is a terrestrial, semi-aquatic species that inhabits coastal areas. Massachusetts is the northern range limit of the diamond-back terrapin. Massachusetts populations are local and may be limited to Wellfleet on Cape Cod (Klemens, 1993).

#### *Avifauna*

Disposal at candidate sites that are contiguous with the shoreline or islands could impact some shorebirds or alter their habitat (Table 4-17). Shorebird habitat consists mainly of intertidal beaches and tidal flats although rocky coasts are preferred by some species. The confined disposal facility sites: north 195, Railyard, and Fairhaven north in New Bedford/Fairhaven Harbor are located in intertidal areas and disposal of UDM there could cause a temporary loss of shorebird habitat. Disposal at Seawall west, Silvershell, and Seawall southwest would create intertidal habitat and therefore increase habitat for shorebirds. No disposal of UDM is proposed in rocky intertidal zone habitat, therefore there would be no impact to shorebirds that inhabit these areas. No principal waterbird colonies were identified in New Bedford/Fairhaven Harbor by Veit and Petersen (1993). At the off-shore aquatic disposal sites, disposal activity may temporarily displace seabirds or waterfowl feeding proximal to the disposal site.

**Table 4-17:** Bird Species Reported to Frequent the Coastal Environments of Southeastern Massachusetts including New Bedford/Fairhaven Harbor and Vicinity

Species name	Scientific Name	Habitat	Status	Source
Common Loon	<i>Gavia immer</i>	Open waters	C/W, MA SC	1
Red-throated Loon	<i>Gavia stellata</i>	Open waters	U/W	1
Horned Grebe	<i>Podiceps auritus</i>	Open waters	U/W	2
Red-necked Grebe	<i>Podiceps grisegena</i>	Open waters	U/W	2
Gannet	<i>Morus bassanus</i>	Open waters	U/W	2
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	Open waters	N/C	1
Great Cormorant	<i>Phalacrocorax carbo</i>	Open waters	U/W	1
Great Blue Heron	<i>Ardea herodias</i>	Intertidal	N/C/W	1
Great Egret	<i>Ardea albus</i>	Intertidal	N/C	1
Snowy Egret	<i>Egretta thula</i>	Intertidal	N/C	1
Green-backed Heron	<i>Butorides virescens</i>	Intertidal	N/C	1
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Intertidal	N/U	1
American Bittern	<i>Botarus lentiginosus</i>	Intertidal	U, MA E	1
Mute Swan	<i>Cygnus olor</i>	Open waters	N/C/W	1
Canada Goose	<i>Branta canadensis</i>	Open waters	N/C/W	1
American Brant	<i>Branta bernicla</i>	Open waters	C/W	1
Mallard	<i>Anas platyrhynchos</i>	Open waters	N/C/W	1
Black Duck	<i>Anas rubripes</i>	Intertidal	N/C/W	1
Blue-winged Teal	<i>Anas discors</i>	Intertidal	N/U	2
Red-breasted Merganser	<i>Mergus serrator</i>	Open waters	C/W	1
Common Goldeneye	<i>Bucephala clangula</i>	Open waters	C/W	1
Bufflehead Duck	<i>Bucephalis albeola</i>	Open waters	C/W	1
Oldsquaw	<i>Clangula hyemalis</i>	Open waters	C/W	1
King Eider	<i>Somateria spectabilis</i>	Open waters	U/W	1
Common Eider	<i>Somateria mollissima</i>	Open waters	C/W	1
Greater Scaup	<i>Aythya marila</i>	Open waters	C/W	1
Canvasback	<i>Aythya valisineria</i>	Open waters	C/W	1
Black Scoter	<i>Melanitta nigra</i>	Open waters	C/W	1
Surf Scoter	<i>Melanitta perspicillata</i>	Open waters	C/W	1
White-winged Scoter	<i>Melanitta deglandi</i>	Open waters	C/W	1
Osprey	<i>Pandion haliaetus</i>	Intertidal	N/C	1
Northern Harrier	<i>Circus cyaneus</i>	Intertidal	N/C/W, MA T	1
American Kestrel	<i>Falco sparverius</i>	Intertidal	C/W	1
Clapper Rail	<i>Rallus longirostris</i>	Intertidal	N/U/W	1
King Rail	<i>Rallus elegans</i>	Intertidal	U, MA T	1
Killdeer	<i>Charadrius vociferus</i>	Intertidal	U	1
Semipalmated Plover	<i>Charadrius semipalmatus</i>	Intertidal	N/C	1
Piping Plover	<i>Charadrius melodus</i>	Intertidal	N/C; MA, US T	1
Black-bellied Plover	<i>Pluvialis squatarola</i>	Intertidal	N/C	1
Willet	<i>Catoptrophorus semipalmatus</i>	Intertidal	N/C	1

Species name	Scientific Name	Habitat	Status	Source
Spotted Sandpiper	<i>Actitis macularia</i>	Intertidal	N/C	1
Greater Yellowlegs	<i>Tringa melanoleuca</i>	Intertidal	C	3
Least Sandpiper	<i>Calidris minutilla</i>	Intertidal	C	1
Semipalmated Sandpiper	<i>Calidris pusilla</i>	Intertidal	C	1
Sanderling	<i>Calidris alba</i>	Intertidal	C	1
Herring Gull	<i>Larus argentatus</i>	Intertidal	N/C/W	1
Great Black-backed Gull	<i>Larus marinus</i>	Intertidal	N/C/W	1
Ring-billed Gull	<i>Larus delawarensis</i>	Intertidal	C/W	3
Common Tern	<i>Sterna hirundo</i>	Intertidal	N/C, MA SC	1
Least Tern	<i>Sterna antillarum</i>	Intertidal	N/U, MA SC	1
Roseate Tern	<i>Sterna dougallii</i>	Intertidal	N/U, MA E	1
Belted Kingfisher	<i>Ceryle alcyon</i>	Intertidal	C	1
American Crow	<i>Corvus brachyrhynchos</i>	Intertidal	C/W	3
Fish Crow	<i>Corvus ossifragus</i>	Intertidal	U/W	2
European Starling	<i>Sturnus vulgaris</i>	Intertidal, manmade structures	C/W	2
Saltmarsh Sharp-tailed Sparrow	<i>Ammodramus cuadacutus</i>	Intertidal	C	1, 3
Seaside Sparrow	<i>Ammodramus maritimus</i>	Intertidal	C	3
Song Sparrow	<i>Melospiza melodia</i>	Intertidal	C	2
Red-Winged Blackbird	<i>Agelatus phoeniceus</i>	Intertidal	C	3
Eastern Meadowlark	<i>Sturnella magna</i>	Intertidal	C	3
Common Grackle	<i>Quiscalus quiscula</i>	Intertidal	C	2
House Sparrow	<i>Passer domesticus</i>	Intertidal, manmade structures	C	2

C= Common; U= Uncommon; W = Winters in Buzzards Bay; MA SC, T and E = Massachusetts Special Concern, Threatened, and Endangered

Sources: 1 = Howes and Goerhinger (1996); 2 = Veit and Petersen (1993); 3 = Reinert and Mello (1995)

Note: Environmental aberrations such as storms and abnormal concentrations of bait fish (e.g. sand lance and sea herring) have resulted in the congregation of otherwise normally pelagic birds not listed above (i.e.: Cory's Shearwaters, Greater Shearwaters) in Buzzards Bay.

### *Mammals*

As discussed in Section 5.3.5.2, numerous species of whale, dolphin, and porpoise are found in Massachusetts coastal waters. The highest concentrations occur in and around Stellwagen Bank, 12 to 30 nautical miles off the eastern shore of Massachusetts and far from any potential disposal sites in New Bedford/Fairhaven Harbor. One mammal which is commonly seen in Massachusetts harbors from late September to late May is the harbor seal, *Phoca vitulina*. Seals typically emerge from the water to rest on sheltered and undisturbed rock ledges or boulder beaches. No UDM disposal is proposed for these areas.

None of the candidate disposal sites are located in a specific marine mammal habitat and all local species are mobile enough to avoid any areas of temporary turbidity caused by disposal operations. Therefore, marine mammal presence/absence is not a discriminating siting criteria.



### *Endangered, Threatened, or Special Concern Species*

The Massachusetts Natural Heritage Atlas indicates that there are several estimated habitats of state-listed rare wildlife in or adjacent to the New Bedford/Fairhaven ZSF (Figure 4-37). The nearest estimated habitat of rare wetland species is the tidal marsh on the south end of Silver Shell Beach located along the eastern side of the Outer Harbor on Sconticut Neck. This habitat overlaps the southern portion of the Silver Shell Tidal Habitat potential disposal site. Another notable habitat is the marsh along the eastern perimeter of West Island, which is approximately one-half mile north of the West Island Ledge potential aquatic disposal site.

Due to lack of certain topographic, bathymetric or oceanographic features that concentrate prey, Buzzards Bay is not a significant or suitable habitat for cetaceans (Howes and Goehringer, 1996). Therefore, the marine endangered species occurring in the open ocean waters off the coast of Massachusetts are not expected to occur near the off-shore aquatic disposal sites, and practically never within the harbors. The listed species are mobile and can avoid any temporary impacts from UDM disposal. Therefore, impacts to endangered wildlife species are not a factor in screening aquatic disposal sites.

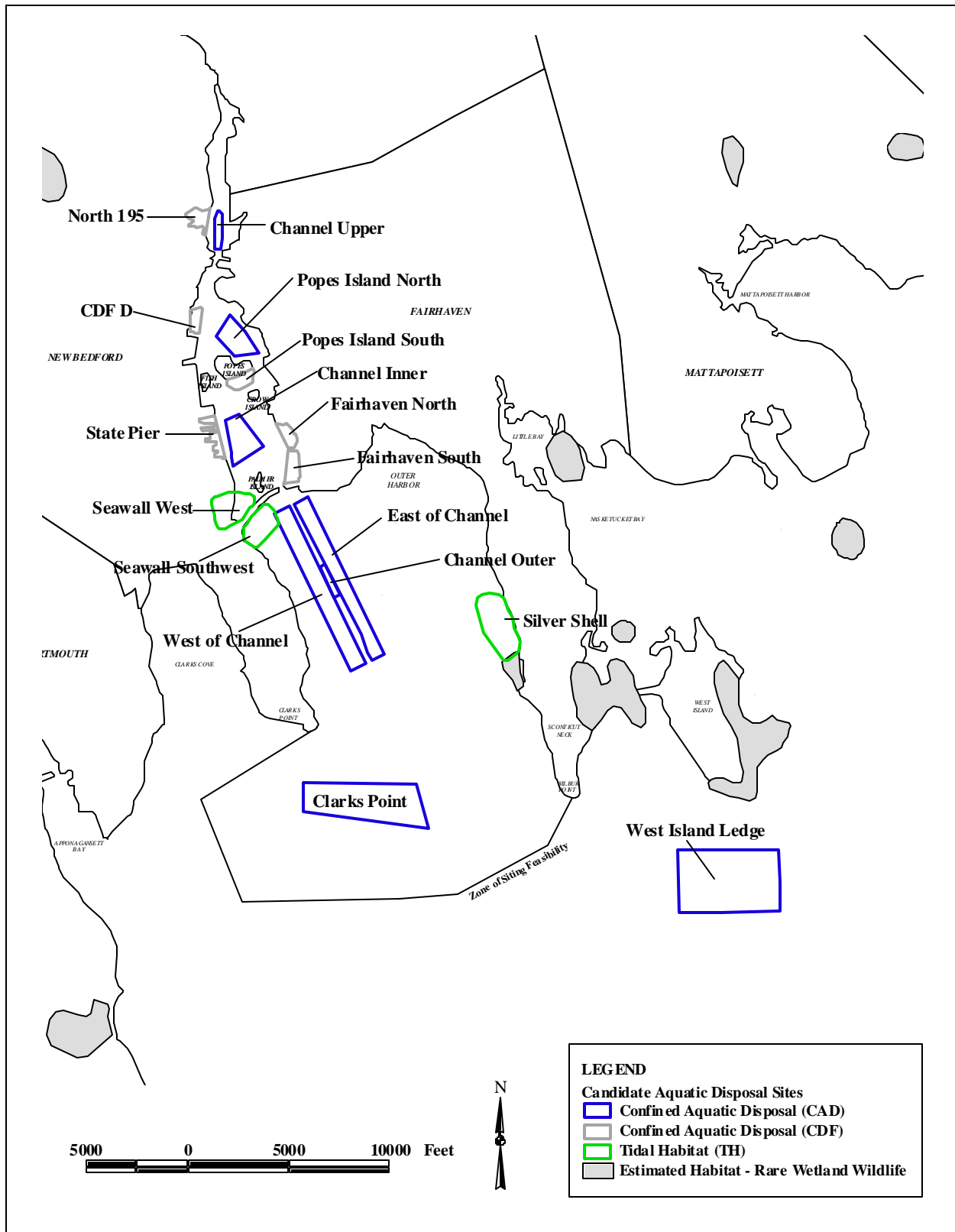
#### 4.8.3.4 Economic Factors

##### *Areas of Recreational and Commercial Fishing*

A series of meetings with local fishermen, both commercial and recreational, were held to discuss the regional fisheries resources of the New Bedford/Fairhaven area. At these meetings, they were asked to map the major commercial finfishing and lobstering areas and to denote which months commercial and finfishing for specific species were practiced. Data collected by the DMF was also consulted.

##### *Recreational Fishing*

Among the more commonly fished recreational finfish species in New Bedford/Fairhaven Harbor are winter flounder, tautog, striped bass, and bluefish. Although these species can be found in almost any area of New Bedford/Fairhaven Harbor, there are certain areas that are most frequently fished (Figure 4-34). Some of these areas are fished because of their easy land-side access (shore sites), while others are fished because environmental conditions favor aggregation of the species. The hurricane barrier, jetties along Clark's point, Fort Phoenix and other areas around the Inner and Outer harbors are reportedly favored shore localities for recreational sport fishing for striped bass, bluefish, tautog, and scup (NBHTC, 1996). Therefore, the Silver Shell TH, Seawall Southwest, Fairhaven North and South sites, or the Pope's Island sites may be proximal to preferred shoreside recreational fishing areas.



**Figure 4-35:** Estimate Rare Wetland Wildlife Habitat

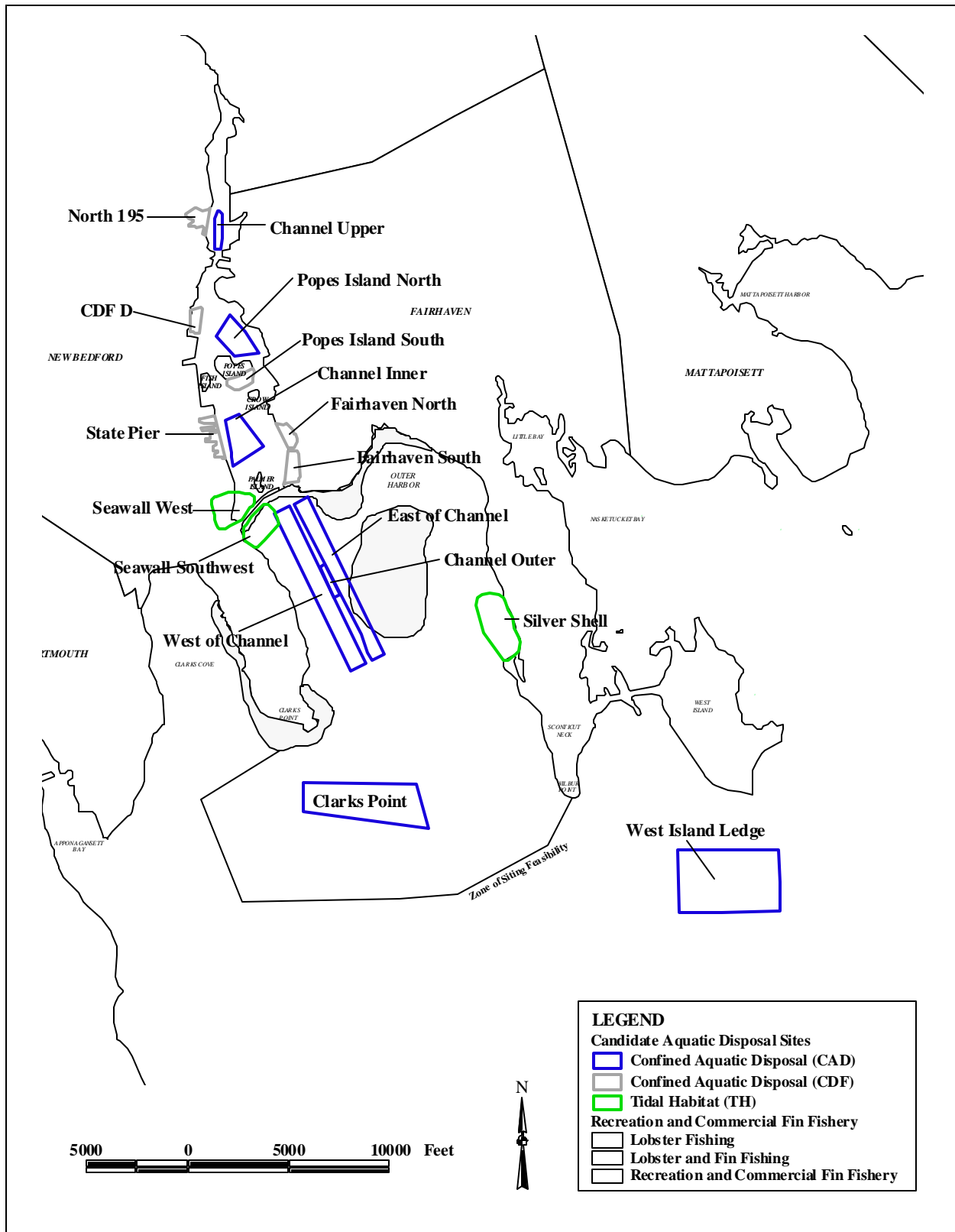
Offshore, DMF mapping depicts recreational fishing areas concentrated around the shallow, rocky areas near the center of the Outer Harbor, near Egg Island and Little Egg Island, and the Butler Flats Lighthouse (Figure 4-36). Fish species found to inhabit areas proximal to the offshore aquatic disposal sites were identified in the DMF groundfish bottom trawl sampling surveys conducted from 1978 to 1996. The closest aquatic disposal site to favored offshore recreational fishing areas is the Clark's Point aquatic disposal site located approximately 1,600 feet south of the end of Clark's Point. The waters off of Clark's Point is a favored fishing area for striped bass, bluefish, and scup (NBHTC, 1996). In addition, DMF sampling revealed that winter flounder and tautog are the most abundant fish species at this location. Abundances of these two species were found to be greater here than at any other aquatic disposal site within the New Bedford/Fairhaven Harbor ZSF.

### *Commercial Fishing*

The Inner Harbor has been closed to commercial fishing since 1979 due to PCB contamination. The Outer Harbor is also closed to the harvesting of lobsters, eels, flounders, scup and tautog. Therefore, commercial finfishing, using gill nets, and lobstering is practiced outside the harbor in Buzzards Bay (Figure 4-37). The commercial fishing done by the New Bedford fleet is concentrated on offshore sites, however, commercial fishing for finfish and lobster is practiced in Buzzards Bay.

Shellfishing, however, is concentrated in Buzzards Bay. Among the most important commercial fish in Buzzards Bay are scup, Atlantic menhaden, striped bass, winter flounder, and bluefish. Quahogs represent the largest commercial shellfish industry in Buzzards Bay, with commercial catch exceeding the catch of all other species (soft shell clam, oyster, bay scallops, surf clams, mussels) combined (Howes and Goehringer, 1996). Lobstering is restricted from most areas of New Bedford/Fairhaven Harbor. However, lobstering is permitted in adjacent Buzzards Bay, south of a line drawn from Hursett Rock off Mishaum point in Dartmouth, east to Rocky Point on West Island in Fair Haven. Lobstering occurs primarily from May to November (Estrella and Glenn, 2000), which typically lies outside of the DEP-designated dredge window. Deeper waters are more commonly fished from late spring/summer to winter. In their comprehensive ecological profile of Buzzards Bay in 1996, Howes and Goehringer reported lobster landings within Buzzards Bay to have remained relatively stable for the prior ten-year period. The catch per three day trap set for Buzzards Bay waters for marketable lobster, egg-bearing lobster, and sublegal lobster were higher than statewide catch rates in 1997.

Because of their mobility and natural changes in environmental conditions from season to season and year to year, the location of good lobster grounds can vary at any time, therefore, the use of adult lobster habitat as a criteria for disposal site screening is not definitive. However, the anecdotal information given above does indicate some general differences in lobstering between local areas in the region. Lobstering is practiced in deeper waters nearly year-round including fall and winter months, when dredging and disposal would occur. Coastal lobstering is most intensive from May to November (Estrella and Glenn, 2000).



**Figure 4-36:** Recreational Fishing Areas

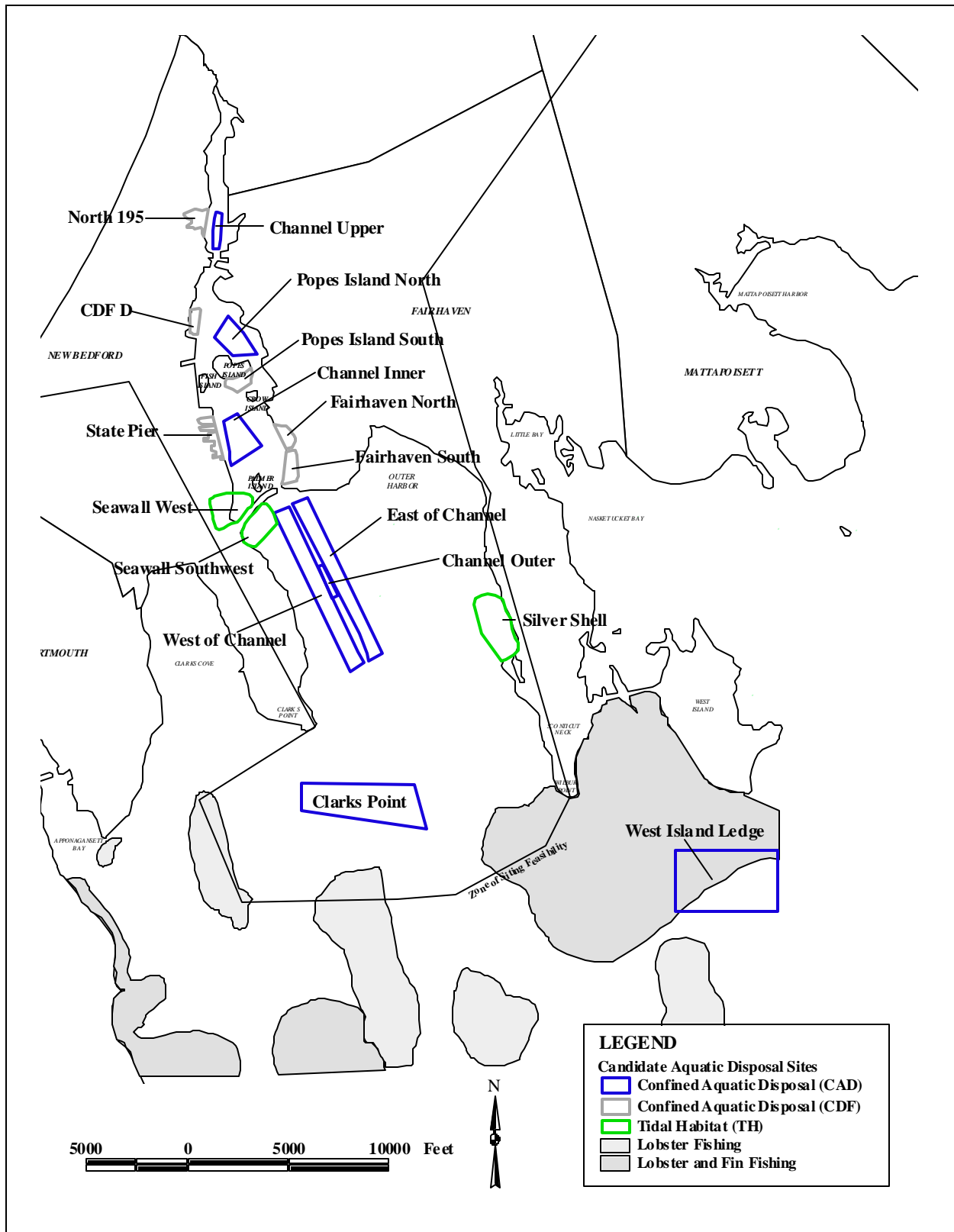


Figure 4-37: Commercial Fishing Areas

#### 4.8.3.5 Regulatory/Practicability/Human Factors

In addition to the physical and biological characteristics of the candidate disposal sites, other factors are important in the screening process. First, the site must be permissible under existing state and federal laws, regulations and policies. Also, the site selection must be consistent with the New Bedford/Fairhaven Harbor Plan and must be amenable to the needs of the public at large. The presence of historic or archaeological artifacts, their preservation and/or documentation, is also a factor in disposal site screening. Cost is also an important factor, as it affects the practicability of using a particular disposal site. These considerations comprise the “practicability” portion of the LEDPA concept under Section 404 of the CWA.

Site permissibility is related to the avoidance, minimization and mitigation of impacts associated with the site. In short, sites that avoid sensitive biological resources are more permissible than those which directly affect these resources. If impacts to biological resources are unavoidable, then means to minimize these impacts would need to be employed. Finally, if an impact occurs, even after minimization measures are employed, then mitigation would be required. The analysis of the candidate disposal sites follows this hierarchy (avoidance, minimization, mitigation) where sites that avoid impacts to natural resources are preferred over those that do not. Likewise, those sites in which unavoidable impacts can be minimized or mitigated, are preferred over sites where impacts cannot be minimized or mitigated.

One aspect of permissibility is the “anti-degradation” provisions of Section 404 of the CWA. These provisions essentially favor dredged material disposal at sites that are already disturbed, as opposed to sites where no human-induced disturbance has occurred. The determination of permissibility is not definitively made until a formal permit application has been made to the USACE. However, numerous meetings were held with the USACE, USEPA, NMFS, and USFWS during the DMMP process, and the permissibility of the candidate sites, among other items, was discussed at these meetings.

#### *Shipwrecks*

Research was conducted to determine the potential for encountering shipwrecks or archaeologically sensitive sites within the candidate disposal sites. This was done using existing literature sources; no field investigations were conducted.

The research revealed a total of 81 historically significant small and large vessels lost within the New Bedford/Fairhaven Harbors and Buzzards Bay, although there are likely others that are not available in the historical record. Exact locations for only two vessels were available and these shipwreck sites are very distant from all potential aquatic disposal sites. Most shipwreck locations cited in contemporary newspapers were quite general, such as “lost off New Bedford”.

The Department of the Interior states that shipwrecks over fifty years old are considered eligible for the National Register of Historic Places. Sixty-one of the shipwrecks identified during the study fit this definition. The recorded locations and dates of the two known shipwrecks were accepted, although it is recognized that the information for either site might be inaccurate.

However, the approximate number of significant shipwreck sites in the study area is considered accurate enough to support an initial screening of the candidate disposal sites.

Neither of the two known shipwreck locations are within or near candidate aquatic disposal sites. Given the large number of recorded and unrecorded wrecks within the ZSF, any of the candidate disposal sites could contain shipwrecks. Therefore, any aquatic alternatives explored in the FEIR will include a site specific archaeological survey.

The potential for Native American archaeological sites within the ZSF is highest near the existing coastline, therefore, all but the two off-shore sites would have the greatest potential for archaeological remains. Since little is known of the prehistoric Indians of the study area, any remains, whether a village, fish processing site, or sunken canoe, would be of great importance.

Sub-bottom profiling data indicate that the area has an irregular bed rock which is typically covered by 0-12 feet of glacially deposited medium sand, silt and clay sediment. Remains of any archaeological sites would be extremely hard to locate under the sediment. Field investigation to verify the presence/absence of historical and archaeological resources within the preferred disposal site will be conducted at a later date.

### *Compatibility with the Harbor Plan*

The selection of a disposal site for UDM, as a concept, is supported by the New Bedford/Fairhaven Harbor Plan, which recommends the pursuit of the maintenance and improvement dredging projects in the harbor (Refer to Section 3) and a disposal site for the UDM generated from these projects. The Harbor Plan also supports maintenance and improvement dredging activities as well as the concept of aquatic disposal of UDM. In fact, the Harbor Plan specifically identifies CDFs for the Railyard area and Popes Island North as integral elements of proposed marine industrial expansion.

### *Costs*

To estimate the potential cost of aquatic disposal options, cost estimates (per cubic yard) from a variety of recent dredging studies were compared. Estimates are available from the BHNIP, New Bedford Harbor Cleanup Plan, Salem PD, EPA Assessment and Remediation of Contaminated Sediments (ARCs) program, projects in New York and New Jersey, and the US Navy EIS on Homeporting for the Seawolf Submarine. Recognizing that site specific cost estimates for the preferred alternative will not be discussed until Section 5, the mean of estimates from the BHNIP was determined most applicable for comparing aquatic disposal alternatives in the DMMP. Table 4-18 compares the costs associated with aquatic disposal options considered in the New Bedford/Fairhaven Harbor DMMP DEIR.

**Table 4-18:** Aquatic Disposal Cost Comparison

Disposal Type	Cost per Cubic Yard	
	Range	Mean
CAD - pit	\$35 -55	\$45
CDF <sup>1</sup> (above mean high water)	\$38 - 61	\$50
CDF/TH (± mean low water)	\$45 - 241	\$142
CAD - mound	\$16 - 33	\$24

*1 - Unit cost does not include decking/structures required for CDFs intended to be used as maritime commercial/industrial facilities*

The highest aquatic disposal cost is for CDF/TH. Costs associated with creation of habitat are relatively high because engineering is complex, marine structures are often needed to create the proper hydrologic environment, and manual labor is needed for planting. Most significantly, projects involving tidal habitat creation typically do not involve very large volumes of dredged material, therefore, the unit cost for disposal is often high. Additionally, the unit cost for CDFs intended for maritime commercial/industrial uses, are widely variable due to use-specific support and decking requirements, potentially resulting in a unit cost beyond the upper limits of the CDF/TH unit cost.

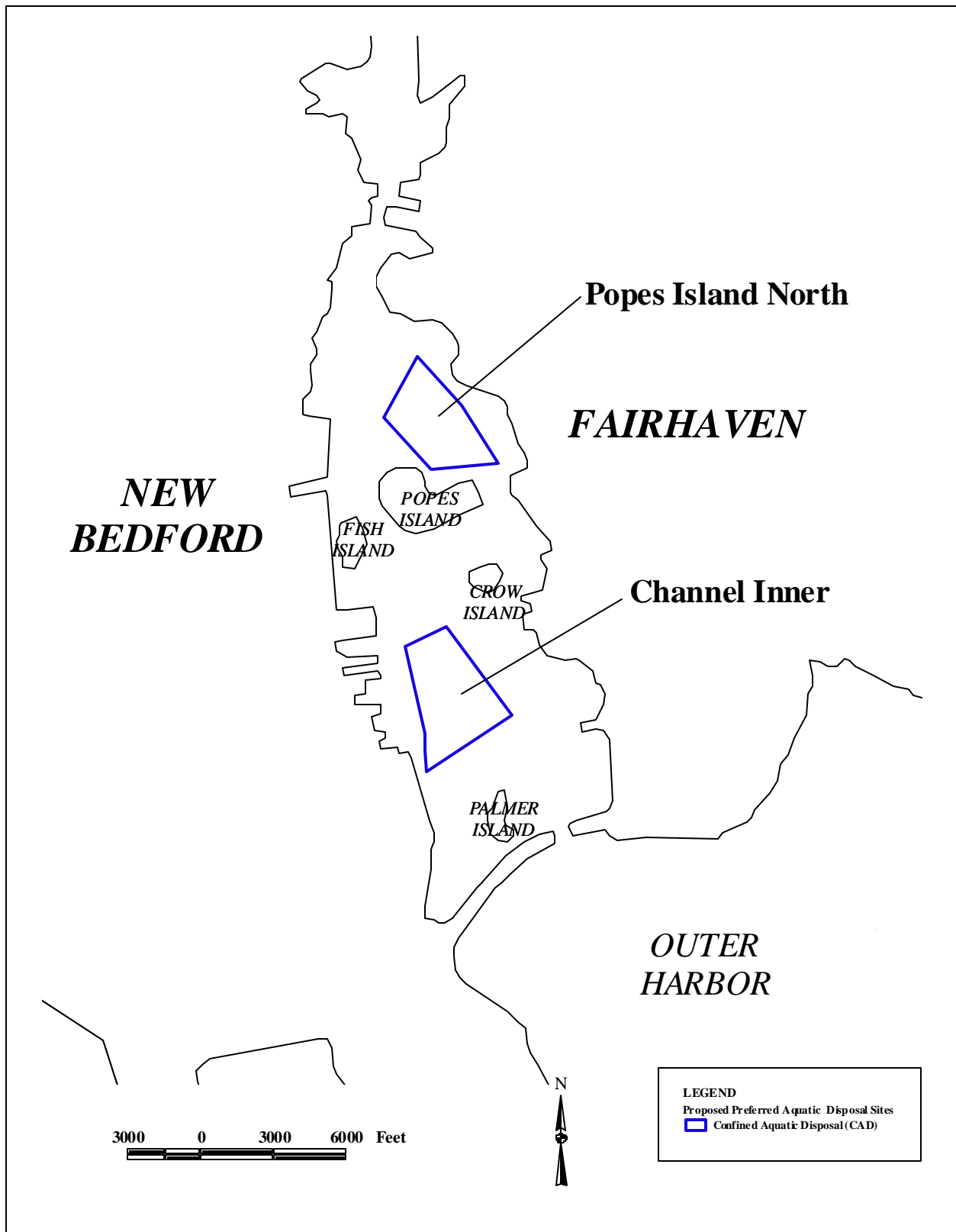
Conversely, CAD disposal in a mound configuration is the least expensive method of disposal because it involves less sophisticated engineering and no manual labor. Development of a CAD pit and subsequent disposal of UDM would cost approximately \$40/cy, based upon recent bid estimates from contractors for the BHNIP project. Large volumes of UDM can be disposed in open water in relatively short periods of time, thereby reducing costs significantly.

CDF costs are generally higher than CAD options but lower than TH. For the CDF or TH options, an engineered structure composed of sheet pile or stone is needed to contain the material, adding to construction costs. Geotechnical analysis of the UDM before and after placement in the CDF is required and, if an end use that requires structural stability is intended, more detailed geotechnical studies are typically required.

#### ***4.8.4 The Proposed Preferred Aquatic Disposal Sites***

After evaluating and screening the physical, biological, jurisdictional, economic and other factors for the universe of aquatic disposal sites, two sites were selected as proposed preferred aquatic disposal areas. These sites are the Channel Inner and Popes Island North sites (Figure 4-38). These sites (either alone or in combination) have the potential to accommodate the total volume of UDM identified for New Bedford/Fairhaven Harbor. The following sections summarize the key attributes of the proposed preferred alternatives sites as they relate to the screening criteria.





**Figure 4-38:** Proposed Preferred Disposal Sites

As mentioned earlier in this DEIR, sites with the potential for significant adverse impacts to natural resources, cultural resources/activities or conflicts with Harbor Plan initiatives were removed from consideration as preferred alternatives. The potential sites that were screened out were removed from consideration because of location in areas of high fisheries productivity and commercial fishing activity, proximity to resources, long travel distances, and limited disposal capacity. The site-specific rationale for screening out the remaining aquatic disposal candidates sites is summarized in Table 4-19. Site attributes are summarized in Table 4-20.

**Table 4-19: Reasons Why Candidate Sites Placed on Reserve Status**

<b>Site Name</b>	<b>Rationale</b>
<b><i>Upper Harbor Sites</i></b>	
Channel Upper	Low capacity, restricted access (bridge)
North 195	Intertidal Impacts; eliminated from consideration as a CDF as part of EPA ROD II
CDF D	Site of ROD II CDF “D”
Fairhaven North	Southern portion conflicts with existing marina, need to extend sewer outfall, low capacity
<b><i>Inner Harbor Sites</i></b>	
Fairhaven South	Intertidal impacts
Popes Island South	Conflicts with existing marina use, cost implications
State Pier	Northern portion actively used for fishing fleet
Seawall West	Intertidal impacts, city prohibition for use as CDF
<b><i>Outer Harbor Sites</i></b>	
Seawall Southwest	Heavy armor required, complex engineering considerations
Silver Shell TH	Inability to create habitat with net increase in value
Channel-Outer	Open shellfish harvest area, fishing impacts, limited capacity
East of Channel	Open shellfish harvest area, fishing impacts
West of Channel	Open shellfish harvest area, fishing impacts
<b><i>Offshore</i></b>	
West Island Ledge	Erosional environment, grain size and bathymetry present difficulties in sequestering material
Clark’s Point	Sewer outfalls, fish resources

**4.8.4.1 Physical Attributes**

- C *Capacity* - Of the two Proposed Preferred Aquatic Disposal Sites in New Bedford/Fairhaven Harbor, the Channel Inner and Popes Island North sites have adequate capacity to accommodate the estimated 960,000 cy of UDM. The amount of expected capacity in Popes Island North is almost three times that of the Channel Inner CAD.
- C *Bottom Type* - The existing bottom type at both sites is soft silty sand or mud, which is similar to the type of dredged material that would be disposed of there.
- C *Distance* - The sites are proximal to all dredging projects in New Bedford/Fairhaven Harbor. This increases the efficiency of dredging and disposal and decreases the chances of accidental spillage of UDM from barges.
- C *Water Depth* - Water depth varies between the two sites from six feet below mean low water (Popes Island North) to 28 feet below mean low water (Channel Inner site), which is sufficient to accommodate the drafts of dredging equipment, however disposal at Popes Island North would require dredging a small entrance channel, 12 feet deep and 250 feet long
- C *Navigation* - One of the sites (Channel Inner) is located within the limits of New Bedford/Fairhaven Harbor Federal Channel. Commercial fishing ships also use the channel, which would require navigation coordination during construction and disposal to avoid disrupting the flow of vessels within the harbor. The sites would not infringe upon seawall docking areas.

**4.8.4.2 Biological Attributes**

- C *Finfish* (Inner Harbor)- The two proposed preferred aquatic disposal sites are expected to have some nursery potential for ecologically and economically important finfish. The Channel Inner and Popes Island North CAD sites are closed to all finfishing activity.
- C *Lobster* - The vicinity of the two proposed preferred aquatic disposal sites are closed for commercial harvest of lobster. The habitat, soft silty sand and mud, is not a preferred substrate for lobsters (located throughout the harbor) however, lobsters are expected to occur proximal to these sites.
- C *Benthos* - Despite relatively high concentrations of metals, PAHs, and PCBs, the sediments of the aquatic disposal sites are well oxygenated and supportive of diverse and abundant benthic invertebrates. OSI values averaged 4 at both Channel Inner and Popes Island North sites.
- C *Shellfish* - Quahogs, located throughout the harbor, are its most economically important shellfish species. Many beds are closed due to bacterial contamination as evidenced by high coliform counts. The Channel Inner and Popes Island North sites lie within prohibited harvest areas. Some areas of the Inner Harbor are used for seed stock and depuration programs. A portion of the Channel Inner site lies within the northern limits of a primary priority contaminated shellfish relay area.

- C *Coastal Wetlands/Submerged Aquatic Vegetation* - The proposed preferred aquatic disposal sites are not located within or adjacent to a salt marsh, intertidal wetland, or an SAV bed. Salt marsh and intertidal areas lie northeasterly of Popes Island North and southwesterly of the Channel Inner site. The closest SAV bed lies to the southeast, outside of the Hurricane Barrier.

#### 4.8.4.3 Economic Attributes

- C *Recreational and Commercial Fishing* -The location of the proposed preferred alternative sites are not in conflict with recreational and commercial fishing as the Inner Harbor is closed to fishing all fishing as a result of Superfund material releases. However, coordination during disposal operations at the Channel Inner site would need to occur to avoid disruptions to vessels using the navigation channel.
- C *Water Dependant Use* - Disposal at the proposed preferred alternative sites would not conflict with existing or proposed water dependant uses. Disposal would not result in any long-term changes to navigational conditions. The timing of disposal activities, in the winter, would minimize the potential for temporary impacts to recreational navigation.

#### 4.8.4.4 Regulatory/Practicability/Human Attributes

- C *Consistency with Harbor Plan* -The sites are not in conflict with the *Harbor Plan*. Both sites are consistent with its goal of maintenance and improvement dredging within the harbor. In particular, the use of the Popes Island North area as a CAD site would not preclude the future use designated in the *Harbor Plan* as a CDF with marine industrial as the proposed end use. area. Use of Popes Island North would also require coordination with the proposed plans to relocate the Route 6 bridge.
- C *Historical and Archaeological Resources* - No known shipwrecks lie within the footprints of the proposed preferred aquatic disposal sites, although further investigation would be needed for verification. Because of their near shore locations, there is potential for encountering prehistoric artifacts from aboriginal inhabitants. The probability of finding and recovering historical or archaeological artifacts within the cells is hindered by years of accumulated sediment.
- C *Practicability/Permitability* - Average unit costs for disposal would be approximately \$34/cy, which is similar to the costs for other CAD pit sites, but higher than for CAD mound sites in the off shore areas. Unit cost is slightly lower for Popes Island North due to smaller footprint requirement as a result of greater depth to bedrock. Similar sites in Boston Harbor have been approved by the USACE and DEP and are currently being used and the project is nearing completion.

**Table 4-20:** Summary of Attributes of Proposed Preferred Alternative Sites

	<b>Channel Inner CAD</b>	<b>Popes Island North CAD</b>
<i>Physical Attributes</i>		
<b>Capacity (cy)</b>	1,222,575	3,226,108
<b>Bottom Type</b>	Mud	Mud
<b>Distance (miles)</b>	1.8	1.1
<b>Water Depth (feet)</b>	28	6
<b>Navigation</b>	Sufficient Depth for Navigation	Adjacent to Federal Channel; shallow depth (<7 feet)
<i>Biological Attributes</i>		
<b>Fisheries</b>	Moderate-High Nursery Potential	Some Nursery Potential
<b>Lobster</b>	Not a Preferred Substrate for Lobsters	Not a Preferred Substrate for Lobsters
<b>Benthos (Mean OSI)</b>	4	4
<b>Benthos (Habitat Complexity)</b>	10	1
<b>Shellfish</b>	Prohibited Harvest; (productive quahog beds throughout. A portion of this site lies within a primary priority shellfish contaminated relay area )	Prohibited Harvest; (productive quahog beds throughout)
<b>Wetlands, SAV</b>	None	None
<i>Economic Attributes</i>		
<b>Recreational/Commercial Fishing</b>	Closed to all Fishing Activity	Closed to all Fishing Activity
<b>Water Dependant Use</b>	Located in Navigation Channel	Not Located in Navigation Channel
<i>Regulatory/Practicability/Human Attributes</i>		
<b>Consistency with Harbor Plan</b>	Supports Harbor Master Plan	Supports Harbor Master Plan
<b>Historic/Archeo-logical Resources</b>	No known resources	No known resources
<b>Cost (\$ per cy)</b>	\$36	\$40
<b>Permittability</b>	Potentially Permittable	Potentially Permittable